

Mining

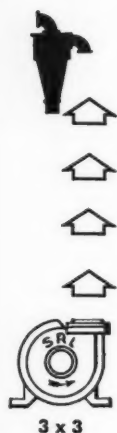


CONGRESS JOURNAL

RESEARCH • ANTHRACITE • BITUMINOUS COAL • CEMENT • ALUMINUM • COPPER • GOLD •
 E • BORON • GYPSUM • LEAD-ZINC • NIOBIUM • PHOSPHATE • **SAFETY** • SILVER • PO
 RARE EARTHS • SULFUR • TANTALUM • NICKEL • **STRIP MINING**
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**ANNUAL
MINING
REVIEW**

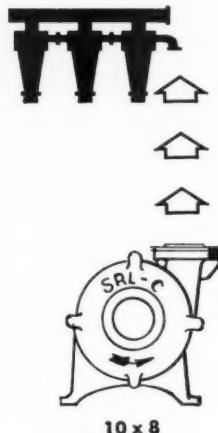
SUM • ASBESTO • GO
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 CHROME • MANGAN
OPEN PIT MINING
 NICKEL • COPPER •
 • URANIUM • RE
 LIMESTONE • MOL
 MERCURY • ANTIM
 BITUMINOUS COAL •



3 x 3



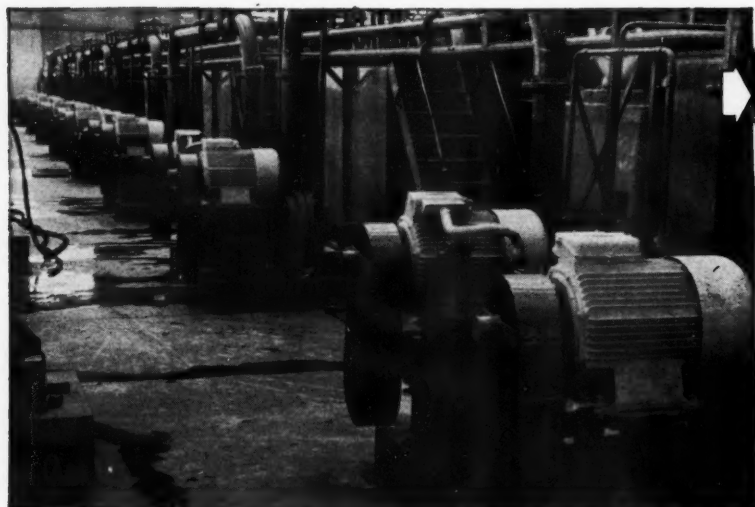
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OTHER SIZES ALSO AVAILABLE

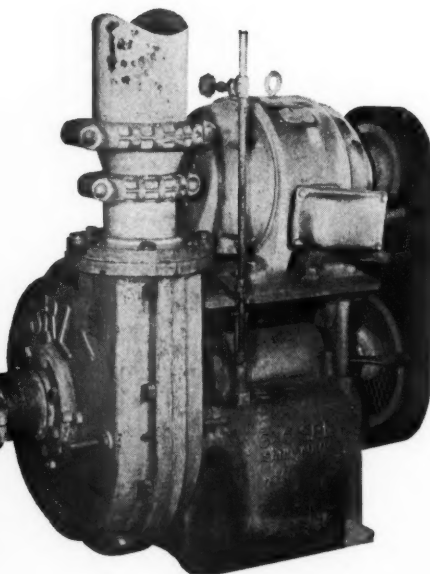
STANDARD for CYCLONE SERVICE...



Sixteen 6" x 6" non-clogging Denver SRL Pumps (eight operating, eight stand-by) deliver mill discharge to the cyclones. Available with pressure molded rubber or alloy iron runners.

Write for Bulletin No. P9-B10.

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EFFICIENT PUMP FOR HANDLING SANDS AND SLURRIES.



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"The firm that makes its friends happier, healthier and wealthier"



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Mining

CONGRESS JOURNAL



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Published Monthly. Yearly subscriptions, United States, Canada, Central and South America, \$3.00. Foreign \$5.00. Single copies, \$0.30. February Annual Review Issue, \$1.25. Entered as Second-class Matter, January 30, 1915, at the Post Office at Washington, D. C.

VOLUME 44 • NO. 2
FEBRUARY • 1958

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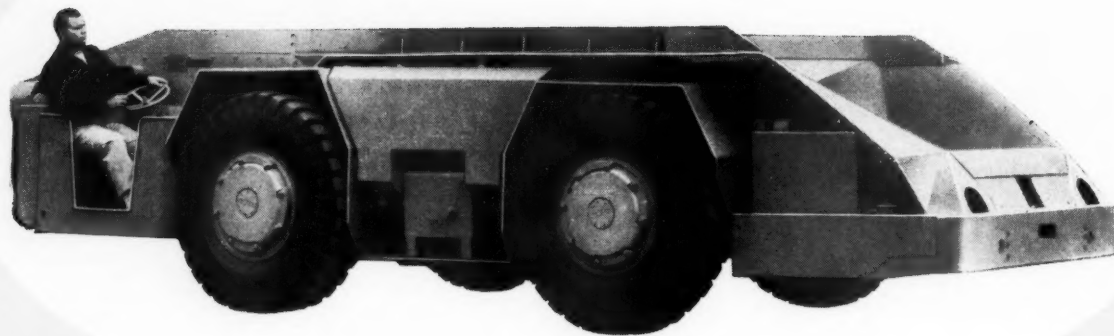
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Your Key To Better



THE NEW

National Mine
Service Company



National Mine

The simplicity and effectiveness of the single prime mover principle for shuttle cars is again proving itself in the new National Mine Diesel TorKars—just as it has in the A.C. and D.C. models of this advanced design of car.

Initially developed and built by one of the nation's largest mining companies, with years of experience, the TorKar was constructed to eliminate the weaknesses found in conventional shuttle cars. The new car so far exceeded expectations in five years of exhaustive testing and actual operation that it was decided to make it available to the mining industry through selection of National Mine as the exclusive manufacturer and distributor.

With excellent facilities and technical assistance, National Mine has further developed the TorKar and produced several different models based on the principle of a single prime mover driving through a torque converter. Now, for the first time, diesel TorKars have been introduced; and already they are establishing new standards for performance and maintenance.

The single-stage torque converter cushions and reduces peak loads and shock, protecting both the engine

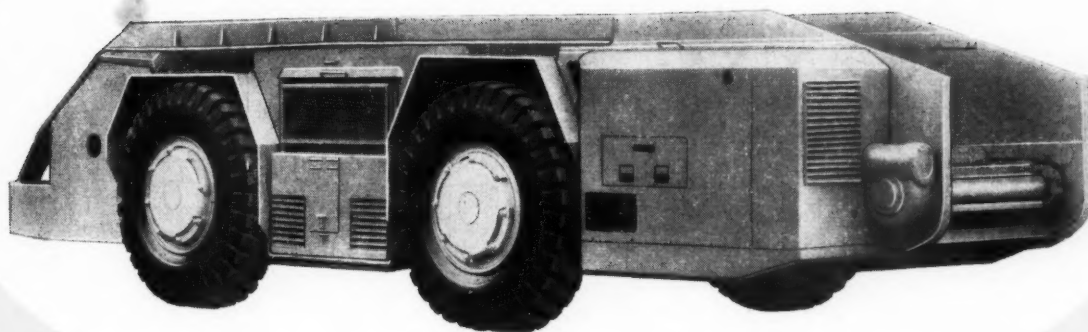
and transmission from excessive wear and reducing maintenance. The three-speed transmission permits the operator to select a gear suitable for the type of grade and roadway. Consequently, engine power is more fully employed and there is no need for over-powering, with all the attendant factors which increase cost of operation and maintenance—and may even affect ventilation.

Among the many plus features of the diesel TorKar are a patented National Mine exhaust gas conditioner which has been used very successfully on various types of diesel-powered underground mining machinery; convenient controls; four-wheel drive and steering; new type interchangeable, heavy-duty spur gear-and-pinion wheel units; abrasive-resistant liners in the hopper and conveyor bed; solid flights; and rugged frame and body.

The design of the diesel TorKar gives it great flexibility, and models are available with tractive characteristics and overall dimensions suitable for almost any mine operating conditions. For full details on these remarkably efficient new diesel shuttle cars, write, or consult your National Mine representative.

**trademark*

Mine Haulage...



DIESEL TORKAR*

Approval No. 2414, U.S. Bureau of Mines, Schedule 24.

Specifications

Capacity: 15 to 18 ton

Length: 24'6"

Width: 111½" overall; body 96"

Wheelbase: 102"

Height: 60" without sideboards

Weight: 34,000 lbs.

Tires: 14.00 x 24, 20 ply

Engine: Optional

Fuel Tank: 60 gal. capacity

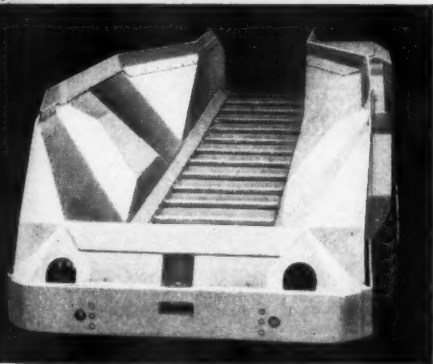
Speed: Loaded car on level—low 2.2 mph; second 3.6 mph; high 5.2 mph.

Transmission: Constant mesh, three speeds forward and reverse

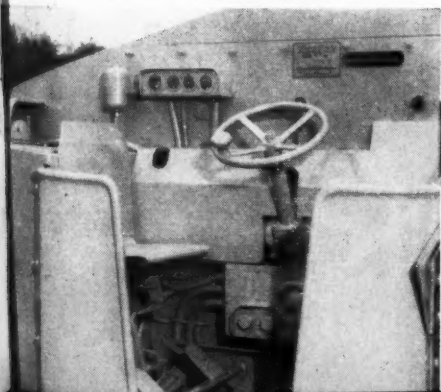
Drive: Torque converter

Steering: Hydraulic power

Exhaust: Patented National Mine exhaust gas conditioner



60" car has 253 cubic feet capacity—sideboards can be added. (below) Controls are conveniently grouped. Clutch lock has "deadman" control.



National Mine Service Company

564 Alcoa Building • Pittsburgh, Pennsylvania

Canada: Mine Equipment Company Limited, Montreal, Quebec

South Africa: Dowson & Dobson Ltd., Johannesburg

Australia: Noyes Bros. Pty. Limited, Sydney

"CAP SCREW" (TYPE-CS) CONNECTORS

BY

Ohio Brass

MANSFIELD

OHIO, U.S.A.

FOR COPPER CABLE TEE CONNECTORS

500,000 cm	22564
750,000 cm	22565
1,000,000 cm	22566

STRAIGHT-THRU CONNECTORS

4, 0	22486
350,000 cm	22487
500,000 cm	22488
750,000 cm	22489
1,000,000 cm	22490

CONNECTOR PLATE
Catalog No. 22551

AMERICAN METAL CLIMAX, INC.

*familiar names
...in a new combination*

A new name in metals—American Metal Climax, Inc.—arises from the merger of two well-known companies, The American Metal Company, Ltd. and Climax Molybdenum Company.

American Metal Climax, Inc. now offers expanded facilities and services. Its activities include mining, smelting, refining, marketing, exploration and research. Its products are molybdenum in all forms, potash, copper, lead, zinc, uranium, vanadium, tungsten, tin, solder, metal powders, precious and rare metals, selenium, germanium, tellurium, cadmium, cobalt, bismuth, arsenic, oil and gas, and others. Its interests circle the globe; principal business activities are in North America, Western Europe, and Africa.

AMERICAN METAL CLIMAX, INC.

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500 Fifth Avenue, New York 36, New York

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Carteret, New Jersey

If You Use Blasting Caps

EXAMINE THESE FEATURES



- 1 DEPENDABLE FIRE**—Special alloy is used as the bridge wire in the firing element of Hercules Electric Blasting Caps. Wire is noncorrosive.
- 2 ENGINEERED SHELL**—Bronze shell of a Hercules cap goes through fifteen separate operations while it is being expertly shaped.
- 3 TOUGH, HIGH DIELECTRIC INSULATION**—Leg wires of Hercules caps are coated with plastic insulation for outstanding toughness, resistance to abrasion, superior dielectric qualities.
- 4 SECURELY ANCHORED**—A cast sulfur plug in the upper part of shell anchors entire firing mechanism in place.
- 5 WATERTIGHT WATERPROOFING**—A special Hercules waterproofing formulation minimizes the possibility of moisture or dampness penetration.
- 6 DOUBLE-PACKED WALLOP**—Bridge wire extends into the priming charge
- 7** and makes positive contact to give rapid ignition.

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INCORPORATED
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New York, Pittsburgh, Salt Lake City, San Francisco





BACKGROUND:

In 14 years of strip mining, the Dulin Bauxite Company, Inc., contracted for dirt removal. The company studied contractors' production records, types of equipment used.

RESULT:

Last year, when the Dulin firm bought its own equipment, it selected Caterpillar-built machines exclusively.

The picture above shows how the firm is using the equipment at its bauxite strip mining operation near Little Rock, Ark. In this pit some 300,000 yd. of overburden are being removed at the rate of 4,200 yd. per day by 3 CAT* DW21 Tractors with No. 470 LOWBOWL Scrapers, push-loaded by a mighty D9 Tractor.

Here is the result of experience in action—and doing fine! Says L. D. Riffe, vice-president of the firm: "We find that this method of moving dirt is the best from the standpoint of high production and economy."

There are plenty of good reasons why these rigs are the best method to move dirt. The DW21-No. 470 combination has the capacity for big-volume hauling—18 cu. yd. struck, 25 cu. yd. heaped. But more important than capacity, the No. 470's LOWBOWL design has greater loading efficiency than any other make of

scraper in its class. Actual tests show that the No. 470 gets its rated capacity load and is on its way while other scrapers are still in the cut, struggling for the last few yards. And when it has its big load, the 300 HP (maximum output) DW21 moves it at high speeds, efficiently.

Let your Caterpillar Dealer show you how these rugged rigs can move material faster and cut costs in your operation. You can depend on him for sound advice now—for fast service and parts you can trust after you buy.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

**WANTED—
THE HARD WORK**



Reg., U.S.
and
foreign
Pat. Offices

In Western States

PATTIN expansion shells are available and serviced exclusively through Colorado Fuel and Iron Corporation, Denver, Colorado. Western mining companies may contact them indirect for information and consultation.

Most mines can Roof Bolt **Effectively and Profitably . . .**

WHILE each mine may be different in physical characteristics, in method of operation or types of equipment used—all mines have one problem in common—the problem of keeping the roof in place.

Hundreds of mines, with all different kinds of roofs, have proved that roof bolting is the best form of roof control. They have also found that bolting leads to increased safety, better ventilation and greater production efficiency. Roof bolting offers so many profitable production advantages it justifies any mine, now using conventional timbering methods, making comparative roof support tests. Bolting tests can be made at very little cost.


To be as effective as possible—roof bolting calls for thorough knowledge of the roof strata—well planned bolting patterns and cycles—proper selection of bolts and shells—and adequate supply and service program. Being "The Pioneer in Roof Bolting"—PATTIN MFG. COMPANY, staffed with experienced roof bolting, mining engineers, is capable of meeting every requirement for quality products and service. Your phone call or letter will get immediate attention.

Shown above is the outstanding PATTIN style D-1 expansion shell. Samples of the "D-1" or "D-2" shells will be furnished upon request.

PATTIN

"69th Year"

MANUFACTURING COMPANY
MARIETTA, OHIO



Shovel clean-up is only one of many jobs Tournatractor handles at Festus, Mo. for Aubuchon Silica Mining Division of Portage-Manley Sand Co. Working in extremely abrasive sand, and across uneven hard rock floors, has been no problem and maintenance costs have been very low.

How Aubuchon keeps ahead of tight production schedules

... cuts costs on tractor maintenance

Pit shovel, to wash plant, to rail car — in an hour. That's a normal scheduling at Aubuchon Silica Mining Division, Festus, Mo. Owned by Portage-Manley Sand & Gravel Co., Rockton, Ill., the firm ships many carloads a week of fine silica used in foundry cores and crystal glass.

Aubuchon does no stockpiling, depends on steady production to fill orders. Extended downtime on any machine, therefore, could halt shipments. One of the major availability problems is that of the pit tractor. Servicing the stripping and clean-up operations over the entire pit and plant area, this machine must continuously cross rough, rocky areas... working in silica so fine and hard it's been described as "sharp as grinding compound".

"Tournatractor® only machine that can do our tractor work..." Since 1952, Aubuchon Silica Mining's tractor jobs have been handled by a rubber-tired LeTourneau-Westinghouse Tournatractor. As Plant Manager Ira Kent says: "The abrasion, rough going, and back-and-forth travel is too rough for crawlers. Tournatractor is the *only* machine we've seen that can do our tractor work."

Tournatractor's main assignments at this pit are stripping overburden to ex-

pose new sandstone, and cleaning up around shovels. But its rubber-tired mounting, sealed anti-friction drive, speed and "go-anywhere" ability let it take on a full circuit of haul-road building and maintenance, stripping, shovel and general clean-up dozing at the pit, mill, and yards.

Maintenance now no problem

How has Tournatractor stood up under conditions so tough? Let Manager Kent tell it: "The last crawler we had was junk inside of 11 months. We've worked Tournatractor 45 hours a week for almost 5 years, *with no real trouble*. On our rough hard rock floors and with free silica sand all over, that's something!

"Our one and only major repair expense in all that time has been replacement of the torque-converter oil-seal and bearings. We've never done anything to the engine... never broke an axle, chipped a gear, or had a single major thing go wrong!"

Ask for a demonstration

Tournatractor has minimized maintenance problems for Aubuchon Silica Mining, while doing a lot of work quickly, efficiently. Investigate now what it can do at *your* pit. Let us send you full facts and arrange for an on-the-job demonstration. No obligation!



Tournatractor has plenty of power to doze rocks too big for pit shovel. Big, rubber-tired machine also cleans up fast to let drilling crew set next charges earlier.



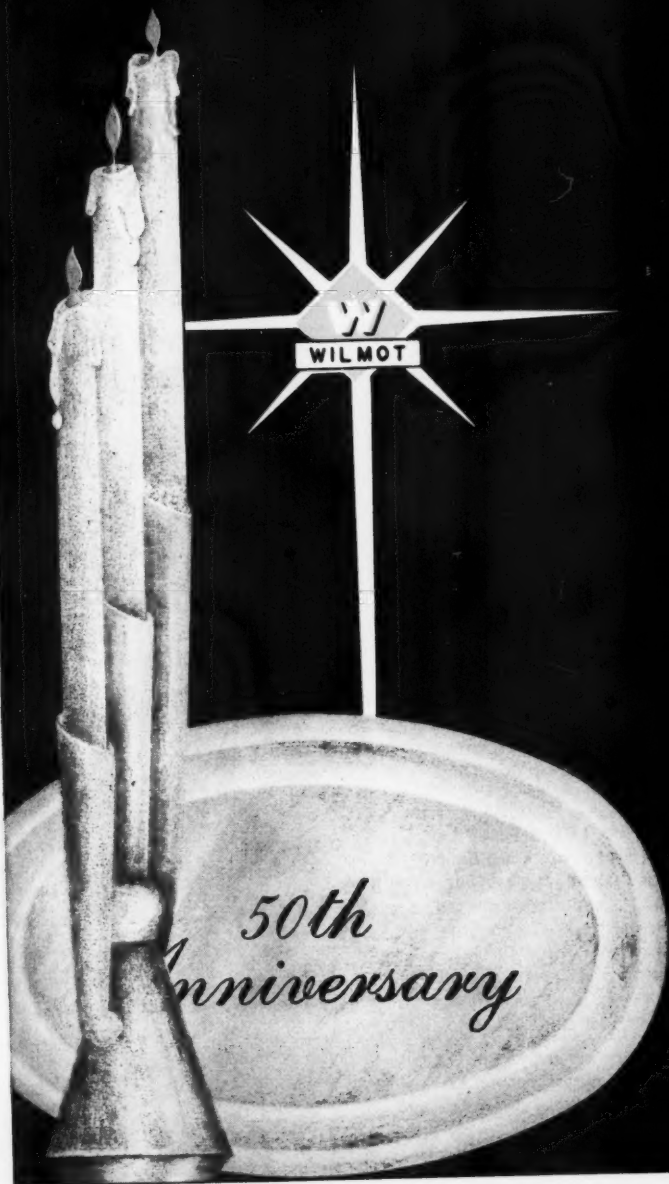
Stripping overburden, Tournatractor slot-dozes — using walls of slot as "natural sideboards". Method keeps dirt from spilling off edge of blade for bigger loads with same effort. "Fill-in" jobs like this keep Tournatractor busy the year 'round.

CT-1500-M-1



LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS
A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT



WILMOT

ENGINEERING COMPANY

WHITE HAVEN, PA.



LeTourneau-Westinghouse Rear-Dump casts 11 tons of steaming slag over edge of waste dump. Unit travels 10 mph faster than smaller competitive hauler working at same location.

heavy-duty unit is proving about 10 mph faster than the rival dumper.

Scraper hauls ore, digs ponds

"D" scraper teams with a tractor-drawn scraper to move 1800 tons of raw ore a day, in two 8-hour shifts. Fast, maneuverable Tournapull also handles many other scattered dirt-moving jobs. Last year it did about 90% of the excavation work for two settling ponds — each 1,000' x 35' x 20'. A third pond of this size is on the immediate work schedule for this machine.

Trailing units interchangeable

The company keeps both its Tournapulls working almost full time, and therefore has individual prime-movers for each. The Rear-Dump and scraper, however, are interchangeable behind the same standard Tournapull prime-mover... and can be switched in a few hours for two-way versatility.

Call or write for specifications on Tournapull Rear-Dumps, scrapers, and other rubber-tired LeTourneau-Westinghouse units that can speed production and cut costs at your pit.

How big chemical firm hauls phosphate ore, hot slag, with Rear-Dump and Scraper

In Central Idaho, a large phosphate producer mines phosphate ore and processes it into liquid phosphorus. Two of the most important haul units in the firm's operation are powered by LeTourneau-Westinghouse 138 hp Model D Tournapulls®.

One "D" prime-mover is hooked up to the standard 9-yd. Tournapull scraper. It is used to load ore from stockpiles, and haul it to grizzlies feeding the plant's conveyor line. The other prime-mover powers a

LeTourneau-Westinghouse 11-ton Rear-Dump. This unit hauls slag from the plant pit to a waste dump.

**2 tons more per load
... 10 mph faster**

The L-W Rear-Dump, together with another dump unit, haul approximately 30,000 tons of hot slag a month. Carrying an average of 11 tons... compared to 9 for the competitive unit... the "D" hauls 835', dumps and returns, in an average of 4.25 minutes. On the haul, this



Wide, unobstructed bowl of Rear-Dump provides easy target for shovel. Hauler maneuvers easily, spots fast at shovel and fill. It turns full 90°, can make complete U-turn in less space than its own length.



"D" scraper loads ore, hauls it to grizzlies... handles other jobs, like digging ponds. Scraper and Rear-Dump units are interchangeable behind any "D" prime-mover.

DRDP-1564-MQJ-1



LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

No matter how it's said . . .



by smoke . . . by drum . . . by phone . . .

There's only one final and revealing conclusion:

A **FAIRMONT** - DESIGNED
- BUILT
PREPARATION PLANT *Satisfies*



Smoke signal, drum talk or word-of-mouth—news about the high performance of Fairmont preparation plants gets around the industry quickly.

Talk with any operator of a Fairmont cleaning plant and you will find him enthusiastic and "completely sold." He will tell you about the uniformity of his product and how his **FAIRMONT**-erected plant has better than 99% separating efficiency through a size range of from $\frac{1}{8}$ " to 10" in any tonnage capacity. You soon note his satisfaction hinges on his cleaner and upgraded coal—his increased sales—his improved profits. All due, as he will frankly tell you, to his modern, well-planned Fairmont installation.

Look into the Fairmont story—send us a signal and we'll be there pronto!

FAIRMONT MACHINERY COMPANY

FAIRMONT, W. VA.

DESIGNERS AND CONSTRUCTORS OF COMPLETE COAL PREPARATION PLANTS USING
BOTH WET AND DRY CLEANING, CENTRIFUGAL AND THERMAL DRYING.

Mine works grader 14 shifts a week on 100 miles of pit roads



Fast-moving Adams 550 grader does lion's share of maintaining more than 100 miles of bench roads at big copper mine. This 123 hp unit grades, ditches, backslopes, does scattered clean-up work.

Two shifts a day, 7 days a week is the rugged schedule of work for a 550 Adams* motor grader at a big southwestern copper mine. 4 to 6 operators take turns manning this heavy-duty unit as it hustles about ... maintaining more than 100 miles of steep, winding mine roads.

Adams handles many jobs

Roads at the mine coil around the huge open pit, along wide benches 15' to 20' high. Surfaced with crushed stone, roads vary in width from one to six lanes. Usually working in 2nd gear, the Adams 550 grades fast and accurately. It ditches, backslopes, does all-around work — such as filling ruts, leveling ridges, and cleaning up debris fallen from banks or spilled from haul units.

Tough assignments, long hours, are right down Adams' alley. Built to withstand severe stress and strain, these graders can take it!

Structurally, the "550" has a big, all-steel box frame for lasting strength and rigidity. It is continuous-welded to take stresses as a unit — from bolster plate to boxed-in

rear end. Streamlined, front to rear, this Adams frame has no sharp bends, no cross-section welds, no bolted or riveted joints to break. Front axle is made of welded heavy bar and plate ... with yokes, kingpins, and spindles of forged, heat-treated steel. This rugged frame foundation, outstanding in the industry, is a basic factor in Adams' accuracy of control, low power loss, and speed as well as its dependability and economy of performance.

Power-wise, the two engines from which you can choose have been job-proven in more heavy-duty construction and road maintenance use around the world, than any other engines available anywhere. Mechanically, all gears and shafts run on anti-friction bearings, and all clutches slide on ball bearings. The 8-speed transmission is the finest ever built for use in a motor grader.

Adams lasts longer, works harder

Net result is a motor grader that lasts longer, works harder ... with less upkeep. From the utility 220 model, with 60 hp ... through 80,

115, 123, and 150 hp sizes ... to the big torque-converter POWER-Flow 660, with 190 hp ... Adams gives you more grader for your money.

Look into the Adams line of heavy-duty motor graders. Your LeTourneau-Westinghouse Distributor has all the facts and will be pleased to arrange a working demonstration of the model that fits your needs best.



Twisting uphill grading is done faster with Adams 550, because it offers several full-power speeds for each kind of work. With 15-speed transmission available, operator can always select gear that will get the most work done at the lowest cost. *Trademark G-1485-M-1



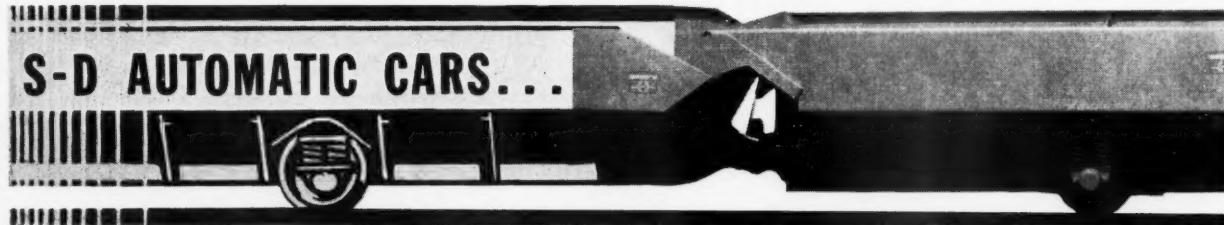
LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

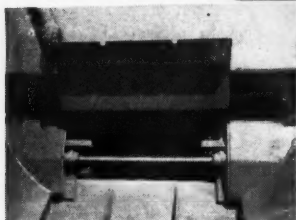
Where quality is a habit.

Another mine car development by Sanford-Day...

S-D AUTOMATIC CARS...



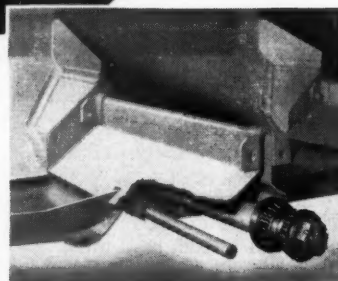
**TWIN
LATCHES
FOR SAFE
AND SURE
LATCHING**



With S-D "Twin Safety Latches" your bottom dumping car doors are actually padlocked twice. They are tripped independently by a pair of tripping devices mounted between rails.

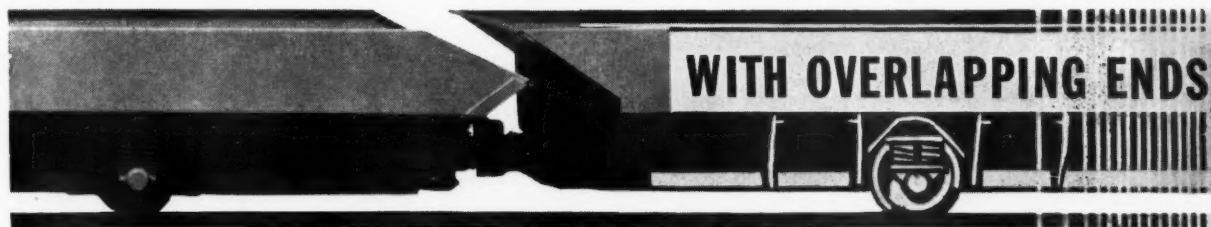
**SAFETY
SEALED
AGAINST
DUST
LEAKAGE**

Cross-sectional view at right points out how flares extend over doors when closed, sealing material in car.



**1/4
to
1/2 TON
MORE
CAPACITY**

If you were buying, for example, 16 bottom dumping cars of any other make with a 4-ton level full capacity, you would need only 14 S-D Automatics of the same overall dimensions to haul the same tonnage. You save two cars in every 16 . . . 12 1/2 percent in original investment . . . 12 1/2 percent in maintenance . . . 12 1/2 percent less dead weight to haul. Any one of our sales engineers will demonstrate to your complete satisfaction just how the construction features of Sanford-Day's exclusive bottom dumping car design give you this extra capacity. Assure yourself of the maximum economies bottom dumping cars offer you by buying S-D Automatics!



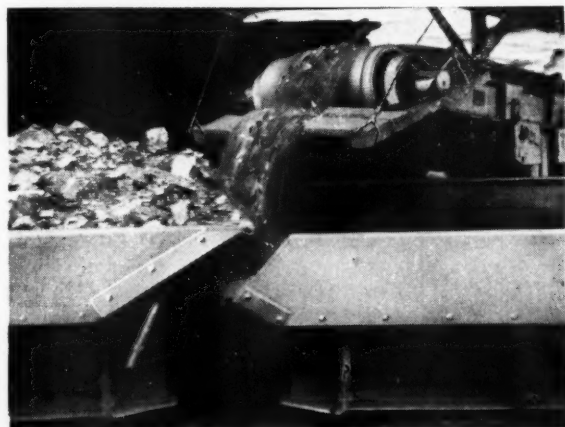
Now available in S-D Automatics only 32" high!

To meet today's mechanization trends the S-D "Automatic" bottom dumping mine car with *overlapping ends* provides the ideal, practical answer to the question, "How can we obtain continuous loading of trips at loading points?"

In addition to others and the S-D "Automatic" illustrated, we recently manufactured and shipped to a Kentucky mining company the same design car, but only 32" high, 6'8" in width, 19' center-to-center of couplers and having an inside body length of 16'. In addition to *overlapping ends*, you also obtain in S-D "Automatics," and only in S-D "Automatics": 1 — "Twin Safety Latches" for safe and sure latching . . . 2 — Cars that are Safety Sealed against dust leakage, and 3 — $\frac{1}{4}$ to $\frac{1}{2}$ ton more capacity per car for the same overall dimensions!

Write us today for complete information! **Sanford-Day Iron Works, Inc., Knoxville, Tennessee.**

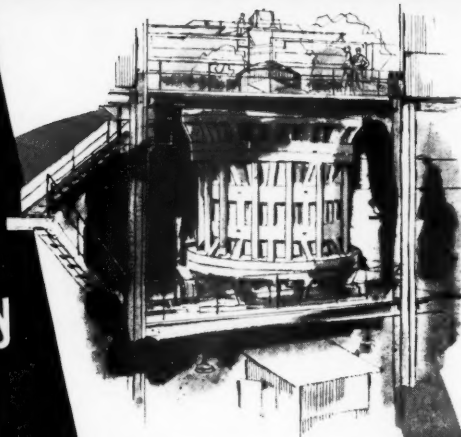
Pictured below is a trip of S-D "Automatics" with Overlapping Ends in actual operation. The car above (and further illustrated at right and left) is one recently ordered by a large company. It is 7' in width, 44" high, 20' center-to-center of couplers with an inside body length of 16½ feet. It further features spring mounted trucks and automatic couplers.



SANFORD-DAY
Knoxville, Tennessee

SYMONS

GYRATORY and CONE CRUSHERS for low cost - big capacity Primary and Fine Reduction Crushing



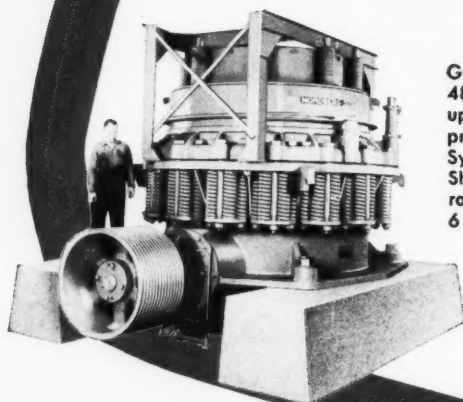
Typical installation of a 60" Symons Primary Gyratory in a large Colorado mining operation.

• For increased productivity at lower ton-hour crushing cost of ores, industrial minerals, cement and rock products . . . think first of Symons Gyratory and Cone Crushers—choice of the world's leading producers.

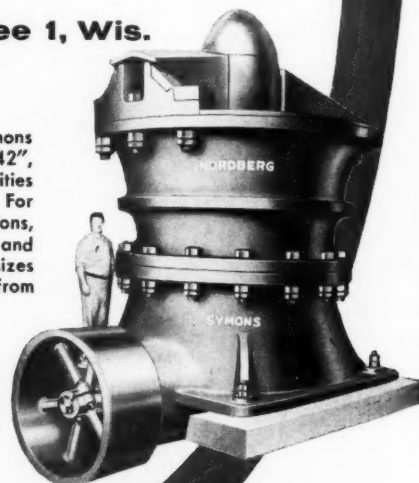
The most important reason behind this preference for Symons is the fact that these soundly engineered, heavy duty crushers produce more material to desired specifications, use less power, give maximum life of crushing members and, in most cases, require less operating personnel.

Nordberg welcomes your inquiry and the opportunity to work with you in helping to solve your specific crushing problems. A copy of Bulletin 247 will gladly be sent upon request.

NORDBERG MFG. CO., Milwaukee 1, Wis.



For heavy duty primary breaking, Symons Gyratory Crushers are available in 30", 42", 48", 54", 60" and 72" sizes, for capacities up to 3500 and more tons per hour. For primary, secondary and finer reductions, Symons Cone Crushers, in Standard and Short Head types, are available in sizes ranging from 22" to 7"—in capacities from 6 to 900 or more tons per hour.



SYMONS . . . a registered Nordberg trademark known throughout the world.



NORDBERG



MACHINERY FOR PROCESSING ORES and INDUSTRIAL MINERALS

NEW YORK • SAN FRANCISCO • ST. LOUIS • DULUTH • WASHINGTON

TORONTO • MEXICO D. F. • LONDON • GENEVA • JOHANNESBURG



NORDBERG GRINDING MILLS

NORDBERG MINE HOISTS



SYMONS VIBRATING GRIZZLIES and SCREENS



NORDBERG ENGINES



© 1957, Nordberg Mfg. Co.

C457

ACME 275

The "Air to Spare" Portable Compressor



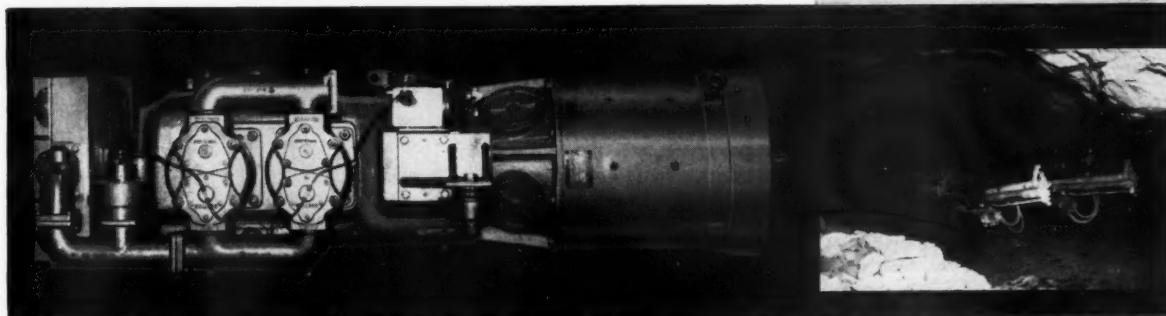
MODEL 275 SELF-PROPELLED

The ACME Model 275 is recommended for taking top and bottom, brushing top or rolls and driving rock headings. Plenty of air assured for operating two drifters or air legs. Air cooled and trouble free with an absolute minimum of vibration.

Also built in non-propelled, skid mounted or track mounted models. Bulletin 275 tells the whole story.

SPECIFICATIONS

Standard Mod. 275-SPR Compressor	
Overall height	. 25½" plus ground clearance
Ground clearance	Variable, 6", 9", 10", 12" Std.
Overall length	. 21'6"
Overall width	. 82"
Actual air delivery	275 CFM
Tire size	. 8.25 x 15 12 ply
Cable reel	. Hydraulic drive, will (if desired) . spool 400' #0 cable
Tramming	. Hydraulic, 2½ MPH, variable
Brakes	. Hydraulic foot brake, mechanical parking brake
Steering	. Full hydraulic power steering
Headlights	. 1 forward and 1 reverse with selector switch
Controls	. Dead man type
Turning radius	. 12'



Two stage compressor which actually delivers 275 CFM of air.

The Model 275-SPRHJ carries 2 drifter arms

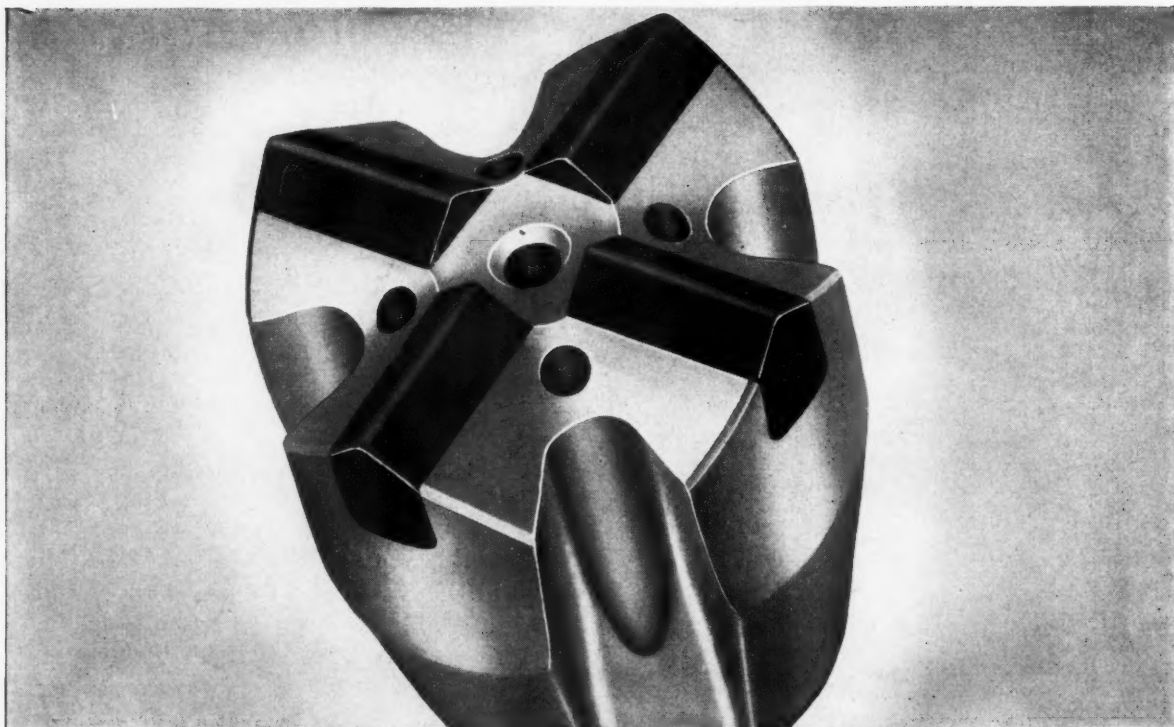


ACME MACHINERY COMPANY

WILLIAMSON, WEST VIRGINIA

WAREHOUSE AND SALES OFFICE
MORGANTOWN, W. VA.

REPRESENTATIVES IN PRINCIPAL
MINING AREAS



Specify Carboloy® carbide inserts in your percussive bits ... drill extra footage between grinds

**Advanced quality control techniques make
Carboloy carbides metallurgically pure ...
more resistant to wear and impact damage**

Carbides for hard rock drilling must have uniform metallurgical consistency and purity. Minute impurities sap strength and abrasion resistance. Even microscopic cracks cause premature insert failure.

Every step in the manufacture of Carboloy carbides is checked and analyzed by the unique Carboloy Quality Control Laboratory. This \$250,000 facility makes sure only metallurgically perfect carbides are delivered to bit manufacturers.

Result: percussive bit inserts that give you more footage per grind. Drilling speeds stay uniformly high. Footage costs come down.

When buying percussive bits, it *pays* to specify Carboloy carbide inserts. For more information, write: Metallurgical Products Department of General Electric Company, 11169 E. 8 Mile Avenue, Detroit 32, Michigan.



\$14,000 emission spectrograph detects impurities of several parts per million. It's just part of the \$250,000 invested in equipment for the Quality Control Laboratory to maintain the metallurgical purity of Carboloy cemented carbides.

CARBOLOY®
CEMENTED CARBIDES

GENERAL  ELECTRIC



This rubber tired cutting machine moves anywhere in the mine . . . cuts anywhere in the seam.



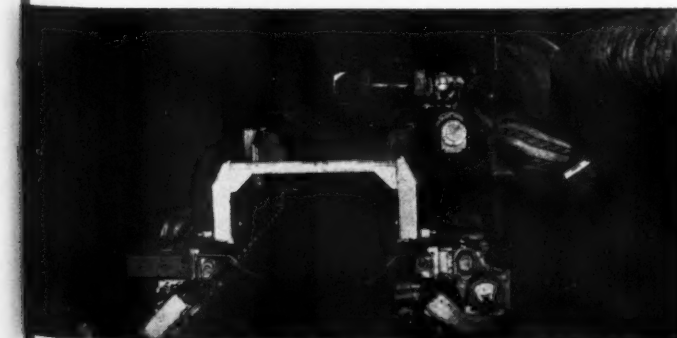
Only 26 1/2" high, this tread-mounted loader has a rated loading capacity of 10 tons per minute.



Goodman makes a complete line of shuttle cars, either AC or DC operation, for high or low coal.



Goodman Continuous Borers have put face efficiency on a new high level at every installation.



The Ropex® extensible belt conveyor moves coal as fast as it can be mined by any continuous miner or loading machine.

Where operating
efficiency is highest
you'll find

GOODMAN Equipment

For fifty-seven years Goodman has paced the industry, meeting and anticipating the demand for higher production at lower cost. In high coal or low . . . for conventional or continuous mining . . . there's a Goodman unit to provide top efficiency in every operation.



The Goodman Ropebelt conveyor is the most useful and practical conveyor available today.



Whatever the length of haul, whatever the load, there's a Goodman locomotive for the job.

If you would like to know more about any of these Goodman machines we'll be glad to send our latest illustrated literature. Write us today.

GOODMAN

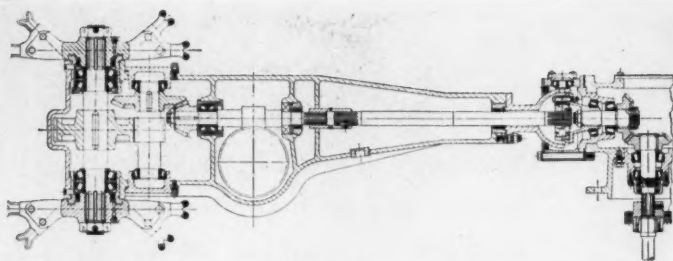
MANUFACTURING COMPANY

Halsted Street and 48th Place, Chicago 9, Illinois

CUTTING MACHINES • CONVEYORS • LOADERS
SHUTTLE CARS • LOCOMOTIVES • CONTINUOUS MINERS

Use Genuine Goodman Replacement Parts

Cuts and loads 2 to 4 tons of coal per minute— **TIMKEN®** bearings take the heavy shock loads



LEE-NORSE mounts the cutter heads and drives of its model CM-33X Miner on Timken bearings as shown above, to take heavy loads, cut maintenance.



CUTTING and loading coal at a rate of 2 to 4 tons a minute sets up heavy shock loads in this Lee-Norse continuous "Miner". Yet, in one shift, it turns out 400 to 500 tons of coal, and with minimum maintenance. The 52 Timken® tapered roller bearings in the Miner help assure this steady performance.

Timken bearings take the shock loads of high speed cutting from any direction. Their rollers and races are case-carburized to have hard, wear-resistant surfaces over tough, shock-resistant cores. Full

line contact between the rollers and races provides extra load-carrying capacity. And because they are tapered Timken bearings take *both* radial and thrust loads or any combination. Bearings and parts last longer.

In an atmosphere of coal and dust, efficient closures are vital. By keeping shafts concentric with their housings, Timken bearings make closures more effective. Dust and dirt stay out. Lubricant stays in. Maintenance is reduced.

To further insure bearing quality, we even make our own fine alloy

steel. No other American bearing maker does. So for your No. 1 bearing value, specify bearings trademarked "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable: "TIMROSCO".



This symbol on a product means its bearings are the best.



TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS ROLL THE LOAD



BIGGEST DIGGER ON TWO CRAWLERS

The 10 yard dipper of this big digger is impressive, for the MARION 191-M is the world's largest loading shovel on two crawlers. Equally important on the iron range is the fast, small-machine cycle time that converts mountains into rail car loads in jig time.

MARION POWER SHOVEL COMPANY • MARION, OHIO

A Division of Universal Marion Corporation

Reinforced overhang
prevents break-offs.

Grey iron centers
keep mounting cost
down, lower stress
concentration.

Quick delivery!
Minimum inventory!

No tread splitting,
because curved plates
support the tread
at load center.

Chilled tread is
harder, lasts years
longer without wear.

No flats, because
tread is ground
concentric to the bore.

Center of Interest

for cost-conscious operators!

In mine after mine, **ACF Load-Support Chilled Tread Mine Car Wheels** give millions of ton-miles of low-maintenance service! Extra quality in every feature gives longer service in every use, minimizes haulage delays for wheel repairs, lowers mine car wheel inventory requirements. Ask your American Car and Foundry representative for facts and figures! **AMERICAN CAR AND FOUNDRY**, Division of **ACF Industries, Incorporated**, 30 Church Street, New York 8, N. Y. *Sales Offices:* New York—Chicago—St. Louis—Cleveland—Washington, D. C.—Philadelphia—San Francisco—Berwick, Pa.—Huntington, W. Va. *Plants:* Berwick, Pa.—Huntington, W. Va.—St. Louis, Mo.

acf

AMERICAN CAR AND FOUNDRY

DIVISION OF ACF INDUSTRIES, INCORPORATED

LOAD SUPPORT MINE CAR WHEELS



Yieldable Arch provides 'safety valve' against squeezing pressures

As its name implies, the Yieldable Arch is designed to give under the squeeze of heavy ground, instead of suddenly letting go. This yielding action gives the overburden a chance to settle slowly into a natural arch around the drift or tunnel.

Each set of Yieldable Arches is made up of rolled U-shaped segments, heavily flanged to resist torsion. Segments nest into one another at the ends to form a sliding joint which is secured by U-bolt clamps. The clamps are drawn up tightly enough to create friction joints which hold fast under normal loads. But when pressures bear down, friction in the joints is overcome and the segments slide, thus acting as a sort of safety valve to keep the steel arch

from buckling or deforming under the crushing load.

Yieldable Arches are easy to install; no special tools or fancy equipment is needed. Your own men can set them up and take them down with only a minimum of supervision. And that brings up another important point: Yieldable Arches are usually recoverable for reinstallation elsewhere in the mine. They frequently pay for themselves within the first year of service. One of our engineers will gladly give you full details on the Bethlehem Yieldable Arch.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

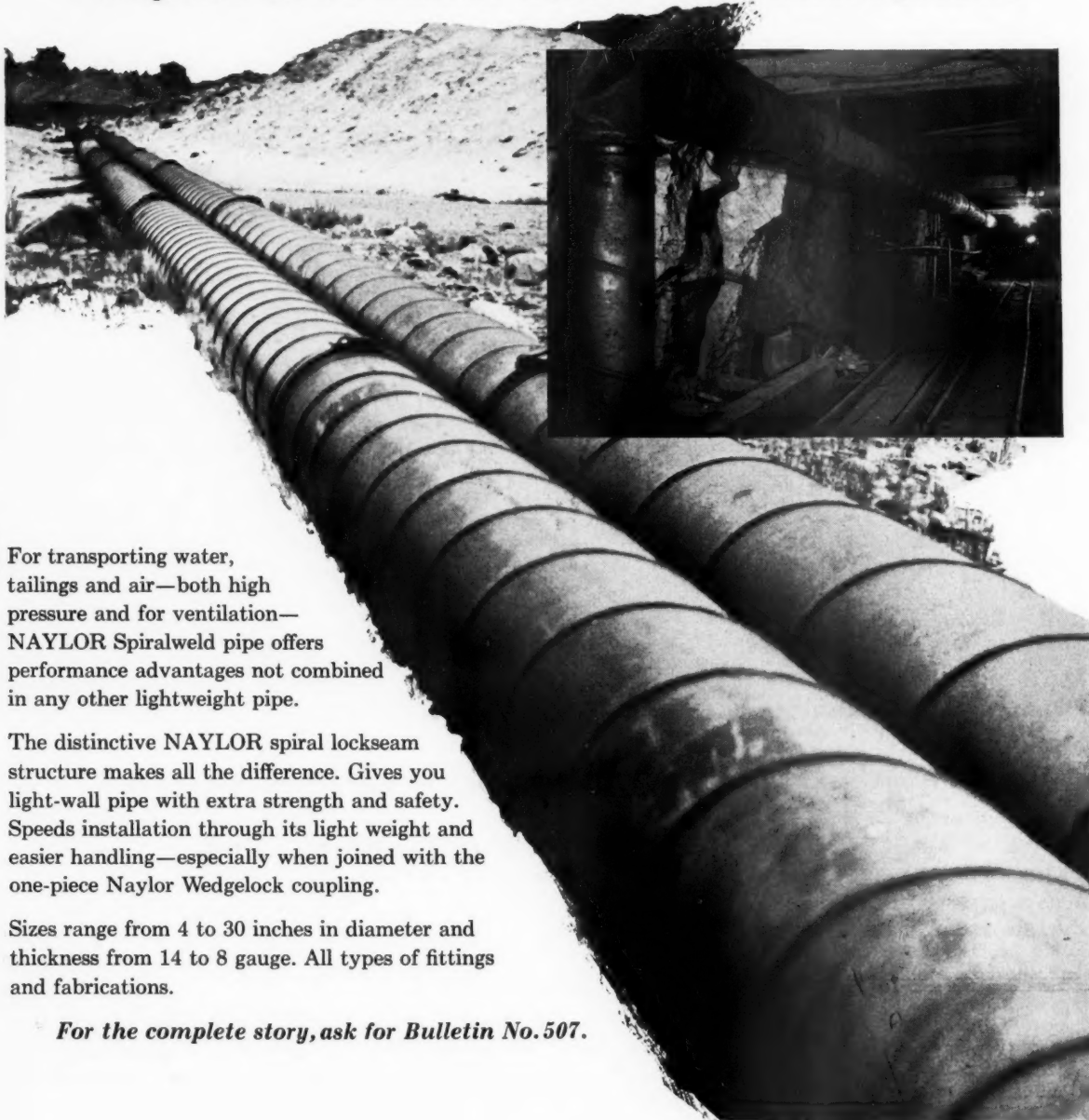
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL



LOW-COST TRANSPORTATION SYSTEM

To Speed Work Above Ground and Underground

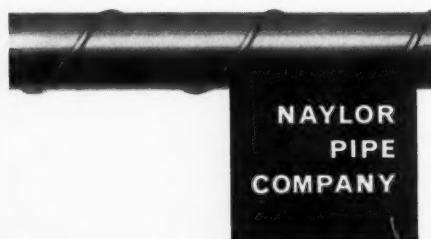


For transporting water, tailings and air—both high pressure and for ventilation—NAYLOR Spiralweld pipe offers performance advantages not combined in any other lightweight pipe.

The distinctive NAYLOR spiral lockseam structure makes all the difference. Gives you light-wall pipe with extra strength and safety. Speeds installation through its light weight and easier handling—especially when joined with the one-piece Naylor Wedgelock coupling.

Sizes range from 4 to 30 inches in diameter and thickness from 14 to 8 gauge. All types of fittings and fabrications.

For the complete story, ask for Bulletin No. 507.



NAYLOR

1278 East 92nd Street, Chicago 19, Illinois

Eastern U.S. and Foreign Sales Office 60 East 42nd Street, New York 17, N. Y.

"Not merely to sell; but to serve . . . not only to make good steel products; but to make them still better . . . not only to fulfill today's requirements; but to anticipate tomorrow's—these are the principles that constantly guide CF&I."

G. F. Franz
President



We've taken our own advice

When any business is "soft", management often uses this period to clean house. All operating methods are examined carefully with an eye toward increasing efficiency by revising or eliminating those practices that hamper productivity—practices that could not be corrected during peak periods.

In the past, there have been times when the demand for CF&I Grinding Balls has exceeded our capacity, and you have had to wait for deliveries. More recently, demand has been off somewhat, and we have utilized this period to improve our own production efficiency, and new equipment has been added to increase our volume. Now we are in a position, when the demand again picks up, to offer you greater production and quicker deliveries from our enlarged stocks of grinding balls. Thus, we have "anticipated tomorrow's requirements"—we have taken our own advice.

We feel sure that most grinding mill operators follow these procedures—that they *do* make a drive toward increased efficiency during slack periods, so that they will be all the more prepared for periods of intensive output. To help you do

this, CF&I has instituted this two-pronged service program:

- 1. Engineering Service . . .** CF&I's Mining Products Engineers are ready to analyze your grinding mill problems; make recommendations on how you can improve your operations.
- 2. Technical Information . . .** CF&I is currently preparing a series of advertisements containing technical information on ways to improve grinding mill operations.

Take advantage of our Engineering Service and look for the ad series in this publication . . . they'll be appearing regularly during 1958 and reprints will be available. The nearest CF&I sales office will be glad to service your needs.

Other CF&I Steel Products for the Mining Industry

CF&I Grinding Rods • CF&I Rock Bolts • Wickwire Rope
CF&I Mine Rails and Accessories • CF&I Industrial Screens
Realock Fence and Fabric • Grader Blades and other
Cutting Edges



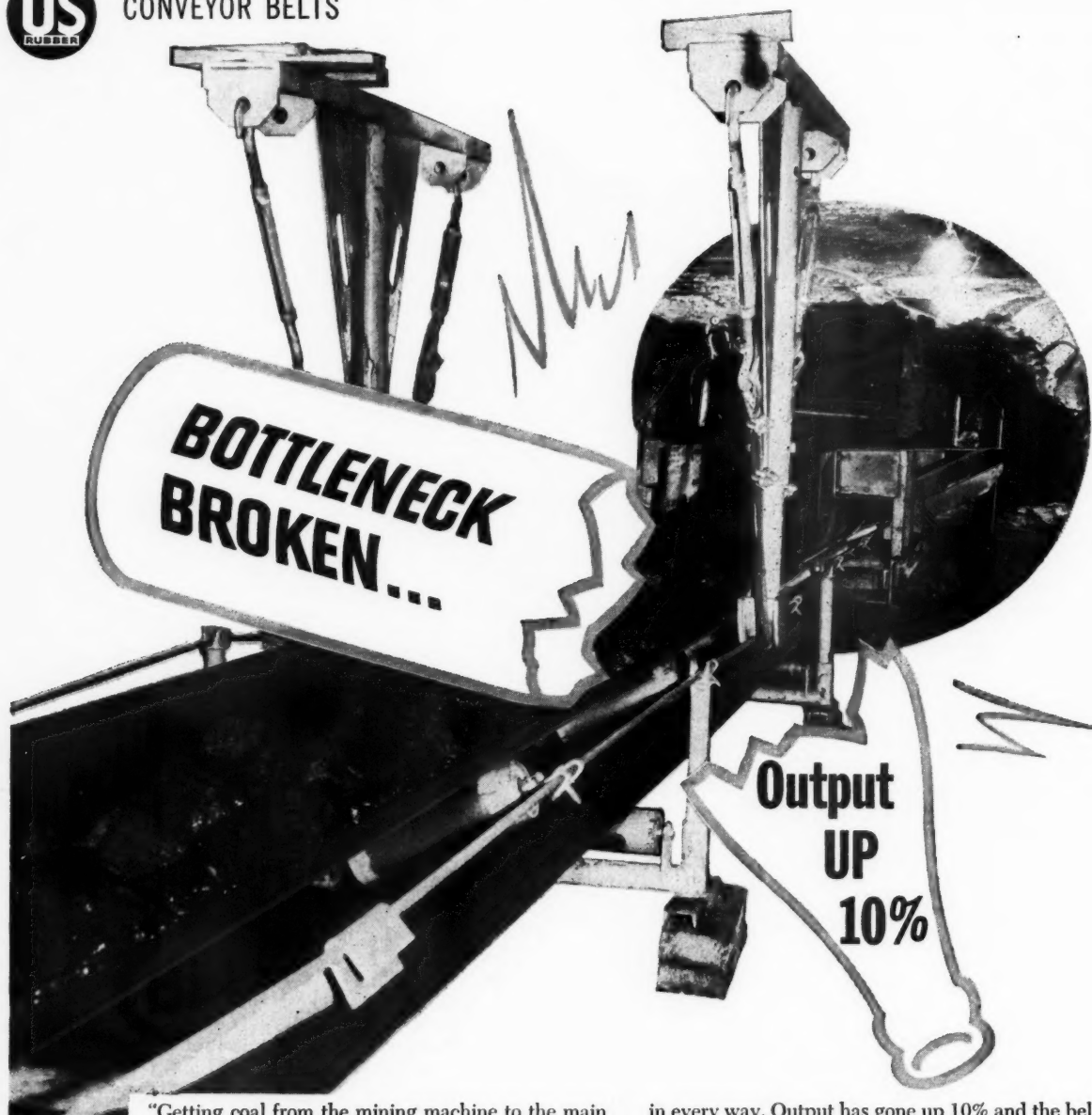
FORGED STEEL GRINDING BALLS
THE COLORADO FUEL AND IRON CORPORATION

Albuquerque • Amarillo • Atlanta • Billings • Boise • Boston • Buffalo • Butte • Casper • Chicago • Denver • Detroit • El Paso • Ft. Worth • Grand Junction
Houston • Kansas City • Lincoln (Neb.) • Los Angeles • New Orleans • New York • Oakland • Oklahoma City • Philadelphia • Phoenix • Portland • Pueblo
Salt Lake City • San Antonio • San Francisco • San Leandro • Seattle • Spokane • Wichita

5662



CONVEYOR BELTS



"Getting coal from the mining machine to the main haulageway used to be one of our main problems," says an executive of Old Ben Coal Corporation. "Then we installed an extensible system of conveyor belts. This eliminated the time-consuming job of continually moving the pit car and putting down and pulling up railroad track to keep up with the mining operation."

Long known in the coal industry as a progressive outfit, Old Ben chose U. S. Conveyor Belts because of the good job they were doing in their preparation plants above ground and because of the belts' proven performance on extensible conveyor systems.

These belts have made a hit with Old Ben officials

in every way. Output has gone up 10% and the belts are practically maintenance-free.

This extensible conveyor* has idlers suspended from wire ropes. The 36" U. S. Giant® MineHaul Belt (Style EN) in use here, provides just the right amount of flexibility to complement this new extensible conveyor system. The belt's resiliency and troughability keep it perfectly trained all the time.

For any materials handling problem, there is a "U.S." belt—plus expert engineering assistance—available at any of the 28 "U.S." District Sales Offices, at selected "U.S." distributors, or write us at Rockefeller Center, New York 20, N. Y.

In Canada, Dominion Rubber Co., Ltd.

*Manufactured and patented by Goodman Mfg. Co.



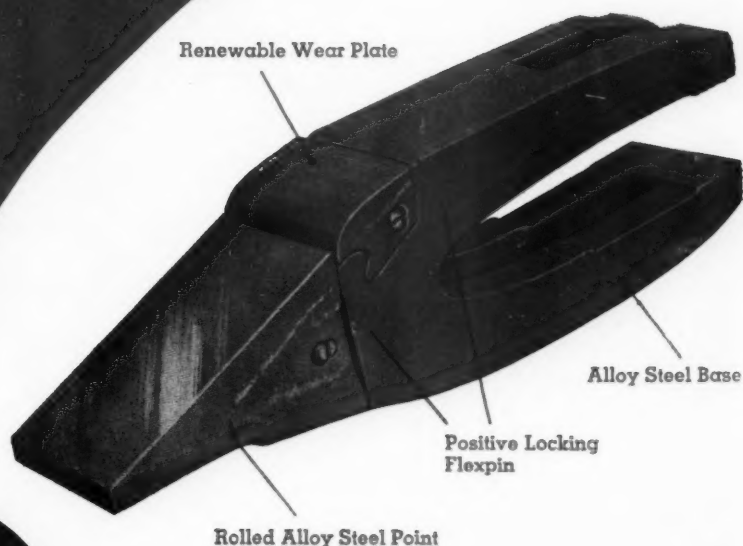
Mechanical Goods Division

United States Rubber



Take advantage of
EXPERIENCE specializing exclusively
in the manufacture of
Teeth that really dig

There is no
substitute for
**FORGED
ALLOY STEEL**



Whistler type shanks for 8 or 10 yd. shovels
with renewable wear plate and forged tooth
point. Both wear plate and point securely
attached with H & L flexpin.



**ALL H & L POINTS ARE MADE OF ROLLED HIGH
ALLOY STEEL (NOT CAST)**

The majority of bases and adapters are also made
of rolled high alloy steel.



TOOTH COMPANY

1540 SOUTH GREENWOOD AVE. MONTEBELLO, CALIFORNIA

NOW... THE JOY



STRAIGHT TRAMMING ... CLEAN BOTTOM

Smooth hydraulic tramming controlled by flow divider distributes power evenly to wide, self-cleaning treads for precise control of straight tramming and turning. Lower trim chain leaves smooth, wide bottom.



EXCELLENT FACE PATTERN ... GOOD ROOF

Notice how the boring arms and trim chains *break* coal from the face for good size consist. Arched sides and smooth trimming of roof gives good roof control.

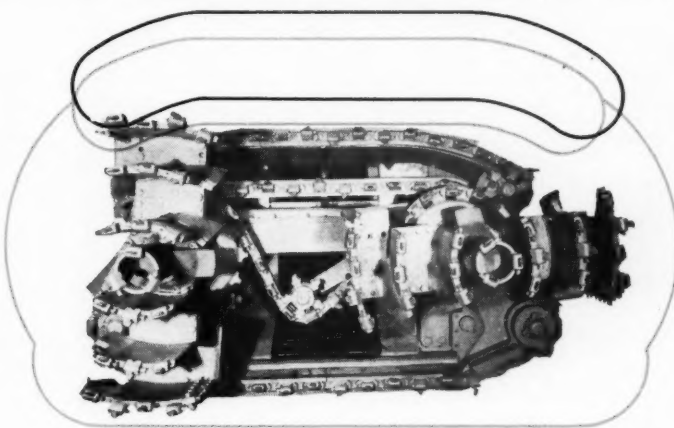
TWIN BORING MINER

***advances 2 feet per minute in a
7 foot seam . . . mines 8 tons per minute***

EXTREMELY FLEXIBLE

There are two separate trim chains. The photograph shows the machine in the fully contracted position used for tramming. The orange line indicates the expanded position used for mining. The black line shows how the top trim chain may be raised or lowered 12 inches *while mining* for instantaneous control of cutting height to follow any seam.

Two sets of mechanically adjusted boring arms provide boring diameters of 72", 76", 80" and 84". Thus the one machine can be adjusted to meet several mining heights.



WSW CL 8727-187

Here's the Joy full-face continuous miner that does any job underground—development work, driving entries, headings, mining rooms and extracting pillars. This versatility is combined with a very high mining rate.

The rate of advance of a full face miner is largely dependent on the weight of the machine and the power driving it. The Joy Twin Borer weighs 40 tons and has a total of 260 horsepower. This weight and horsepower is supported on wide treads so that ground pressure is kept at a low 23 psi. Result . . . unequalled advance through the most difficult seams.

EXTREMELY VERSATILE—Boring pattern is easily changed from 6 ft. to 8 ft. high—from 12 ft. to

13 ft. wide or two other sizes in between. The top cutter chain can be moved 12" up or down *while mining* to follow undulating seams or changing seam thicknesses.

SIMPLE MAINTENANCE—All gear cases, transmissions and electrical controls are mounted on the *outside* of the machine frame. All clutches are the protective slip type.

THESE ADVANTAGES add up to high tons per man and low cost per ton, shift after shift. Talk to a Joy engineer about putting a Joy Twin Borer to work for you. **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: **Joy Manufacturing Company (Canada) Limited, Galt, Ontario.**

WRITE FOR BULLETIN 187-3

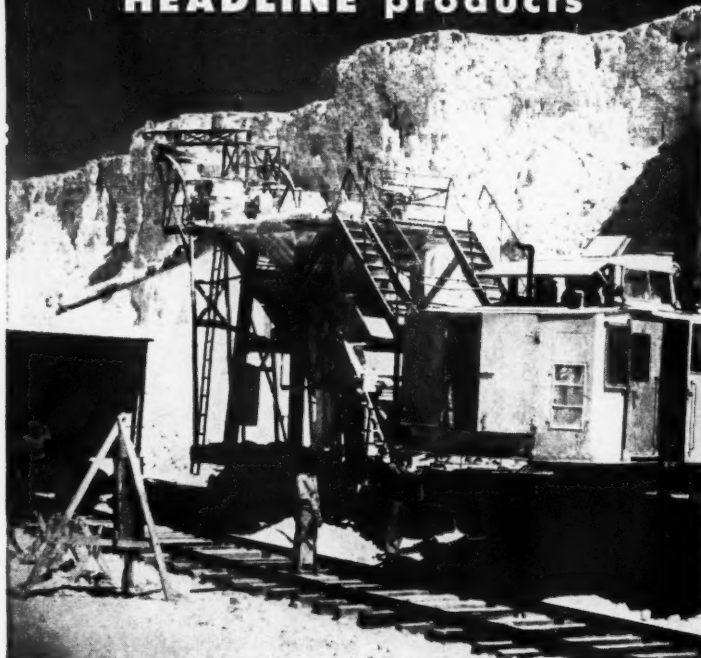
JOY EQUIPMENT FOR MINING...FOR ALL INDUSTRY



CONTINUOUS MINERS, MOBILE LOADERS, SHUTTLE CARS, COAL CUTTERS, CUTTING MACHINE TRUCKS, COAL DRILLS, CONVEYORS, TIMBER SETTERS, SHUTTLE CAR ELEVATORS, BELT FEEDERS, FANS, BITS, PORTABLE BLOWERS, COMPRESSORS, ROCK DRILLS, HOISTS, CORE DRILLS

SULPHUR

helps to create
HEADLINE products



Thiokol®

"Thiokol" synthetic rubber, is an organic polysulfide elastomer. One of its many uses is in solid propellents for long range and high altitude missiles. In liquid form, "Thiokol" synthetic rubber mixed with an oxidizer, is poured into specially designed combustion chambers of rockets. It helps to give stability to the fuel charge and resistance to shock. It promotes uniform burning. When the rocket motor is ignited the mixture burns with great intensity and generates large volumes of gas to propel the rocket.

Solid propellents made with "Thiokol" synthetic rubber have

proved their value in rockets over liquid propellents in many ways: they are less costly and easier to manufacture—simple and rugged construction makes handling and launching easier and safer—fuel tanks and complicated feed systems are eliminated.

"Thiokol" synthetic rubber is a product containing a high percentage of Sulphur—its name being derived from the Greek words for sulphur and glue. Here is another example of the continually broadening field in which Sulphur is an important and necessary element.

**A trade name of Thiokol Chemical Corporation.*



Texas Gulf Sulphur Co.

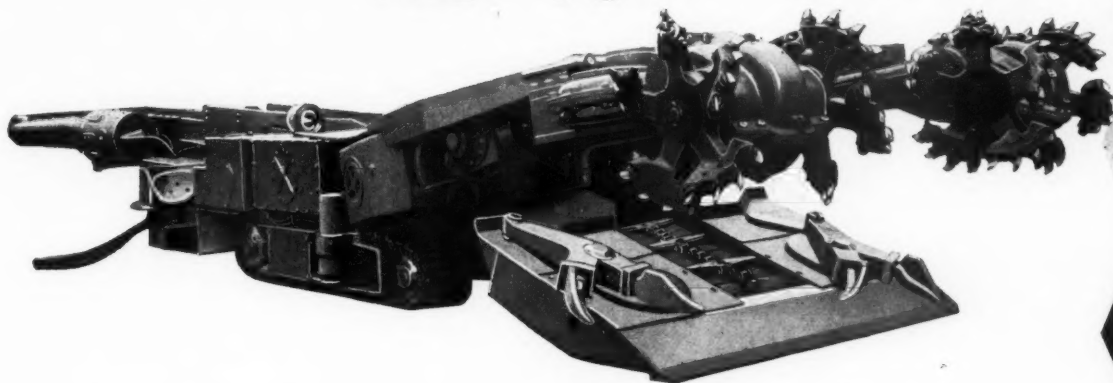
75 East 45th Street, New York 17, N. Y.

811 Rusk Avenue, Houston 2, Texas

Sulphur Producing Units

- Newgulf, Texas
- Spindletop, Texas
- Moss Bluff, Texas
- Worland, Wyoming

HERE'S WHY THOSE WHO KNOW PREFER THE *Lee-Norse* MINER



PATTERN CUTTING—only Lee-Norse has it.

CUTS MORE COAL WITH LESS POWER . . . cutters revolve and oscillate at the same time—milling the coal from the face.

CUTS A COARSE PRODUCT—FEWER FINES . . . cutter bits follow a right and left spiral direction producing a diamond pattern which breaks off in coarse cuttings.

A SIMPLE, STURDY MACHINE . . . essentially a modern loading machine on which is mounted a set of efficient cutting heads.

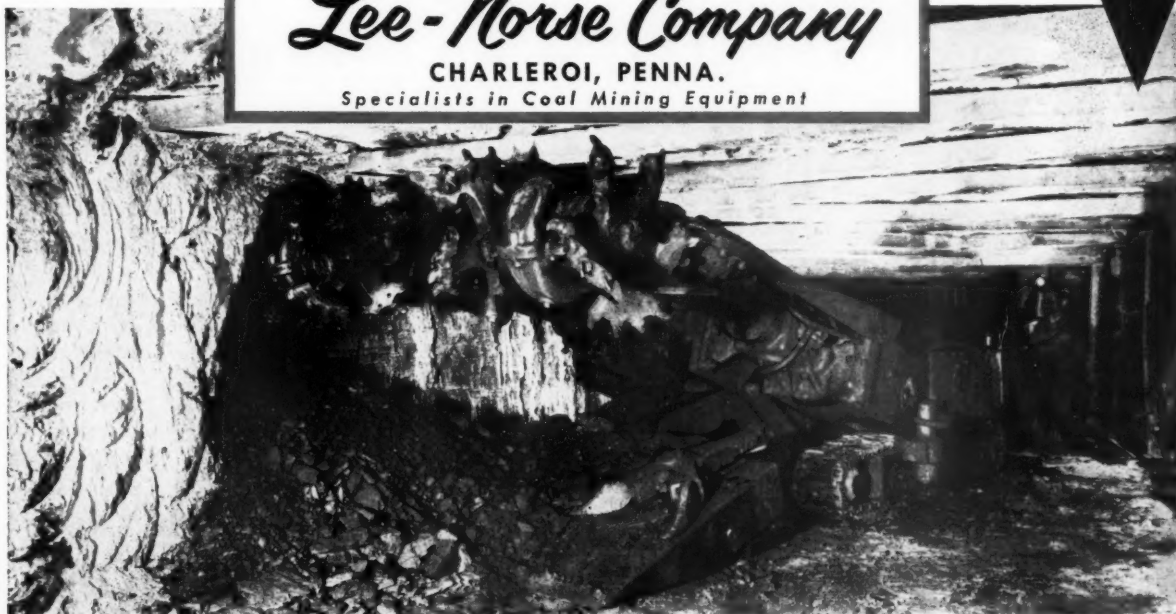
HIGHLY MANEUVERABLE—FAST TRAMMING. . . not a “muscle-bound giant” . . . it quickly follows any variation in seam thickness.

EXCELLENT CLEAN-UP . . . improved dual gathering arms load all the coal into a flexible rear conveyor.

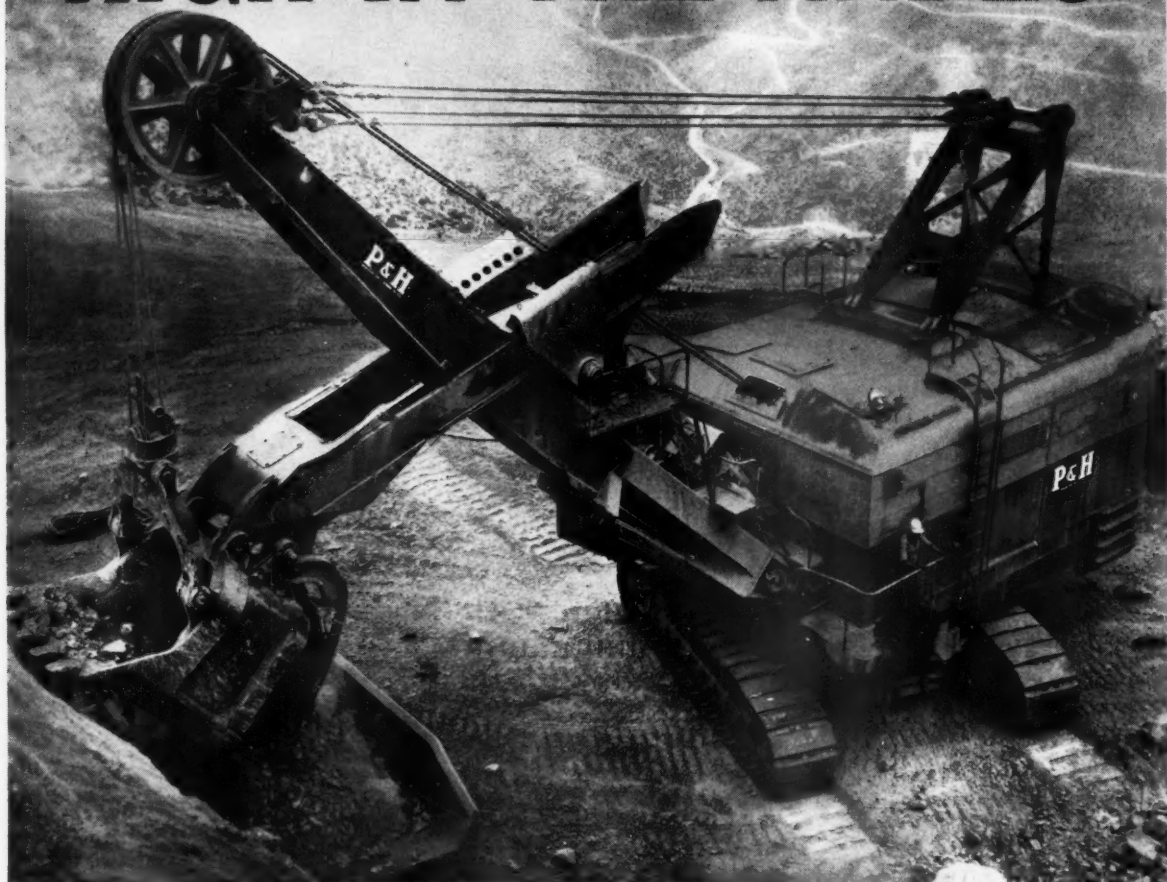
Lee-Norse Company

CHARLEROI, PENNA.

Specialists in Coal Mining Equipment



HIGH IN THE ANDES



ELECTRICS are working for Southern Peru Copper

In their operations as high as 13,000 feet in the Peruvian Andes at Toquepala, Peru, Southern Peru Copper Corporation is using 10 P&H Model 1800 Electric Shovels. Their maximum availability and minimum maintenance are vital to high production.

Only P&H Electric Shovels have these outstanding exclusive features . . . tried and proven in the field.

MAGNETORQUE® . . . the electro-magnetic type coupling that transmits power from the hoist motor to the dipper for faster action, eliminating shock and impact to the


hoist gear train and motor. Response is immediate to varying load conditions.

ELECTRONIC CONTROLS . . . providing the fastest action of any type of control available on electric shovels. All motions are smoother, resulting in consistently higher output.

P&H Electric Shovels offer single source responsibility for all your open pit mining needs from 3½ through 10 cu. yds. capacity.

HARNISCHFEGER

Construction & Mining Division
Milwaukee 46, Wisconsin



**hard and
tough
to the
core...**

The alloying, forging and heat-treating by Sheffield gives MOLY-COP Balls the right hardness and quality for the long, economical grind. It's why MOLY-COP Balls are still THE STANDARD OF COMPARISON AROUND THE WORLD

SHEFFIELD



MOLY-COP

TRADE MARK
COPPER-MOLYBDENUM-ALLOY

Grinding Balls

SHEFFIELD DIVISION

ARMCO STEEL CORPORATION

SHEFFIELD PLANTS: HOUSTON • KANSAS CITY • TULSA

EXPORT REPRESENTATIVES

THE ARMCO INTERNATIONAL CORPORATION, MIDDLETOWN, OHIO

MORE POWER AND MANEUVERABILITY WITH "Euc" TC-12's ON THE JOB

Euclid "Twin" used for faster production

The dirt work for extension and replacement of runways at Geiger Air Base in Spokane, Washington, called for 400,000 yds. to be moved in 90 days. From over 1200 hours previous experience with his big Euclid TC-12, contractor Neil Degerstrom knew it was his most productive crawler. So, putting his other tractors on less important work, he used the "Twin" for pushloading scrapers to maintain high production on this rush job.



Heavy dozing jobs prove TC-12 work-ability

On a large scale Pennsylvania stripping operation, the Torqmatic-equipped Euclid "Twin" is leveling spoilbanks, cleaning up around the dragline and building access roads. The TC-12's superior work-ability, speed and easy maneuverability show up in getting these jobs done faster and moving from one location to another more quickly.

**2 ENGINES and
2 TORQMATIC DRIVES**



Compare horsepower, weight, speed, drawbar pull, maneuverability, ease of operation, visibility, etc.—the "Twin" is unmatched. Put them all together and you get low cost performance that proves Euclids are your best investment.

EUCLID DIVISION • GENERAL MOTORS CORPORATION • Cleveland 17, Ohio

Euclid Equipment

FOR MOVING EARTH, ROCK, COAL AND ORE





the profit you left behind

There it lays in the dirt. Your machines and equipment ground off in the grit, pounded off in the rock and ore. You can almost see the wear that shut down your machines too soon . . . idled your men too long . . . bled your profits too much.

Is there *one* material, *one* metal that can stop this excess wear waste?

One? It takes many alloys, engineered alloys (some you may never have heard of). It takes a list of Amsco® Alloys to span the entire range of wear applications.

Amsco Alloys that can work a full shift where severe abrasion knocked out toughest metals in

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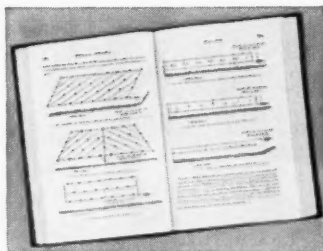
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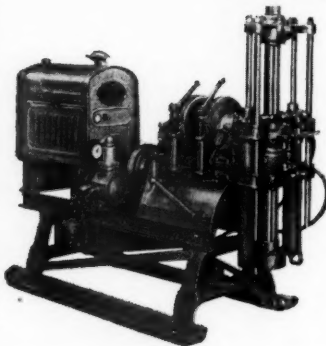
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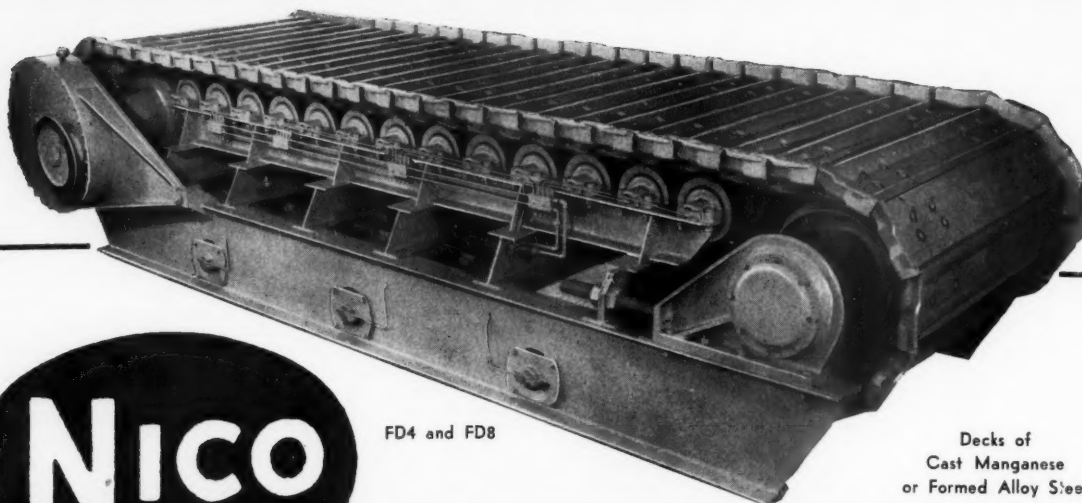
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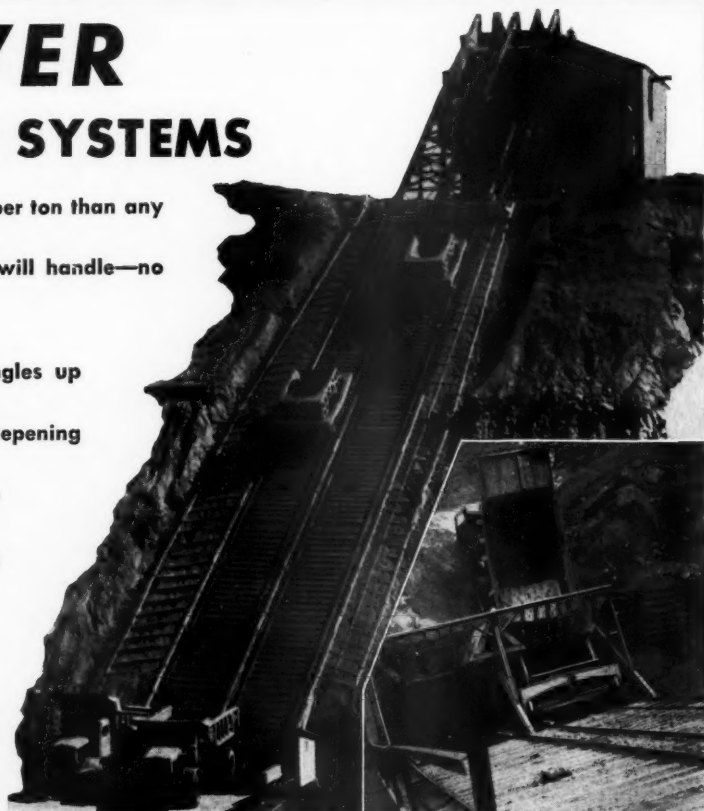
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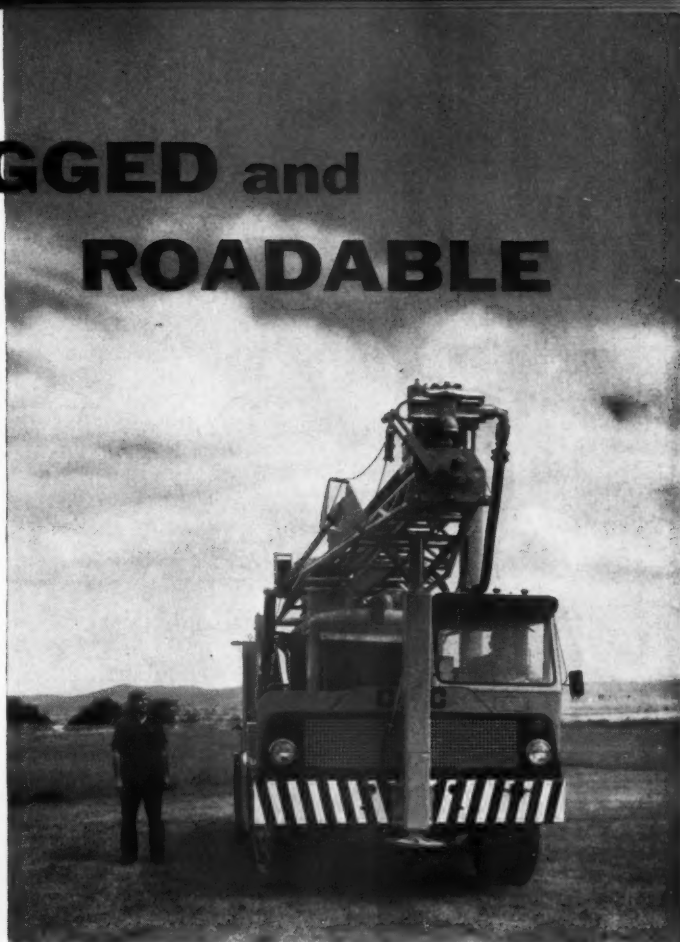
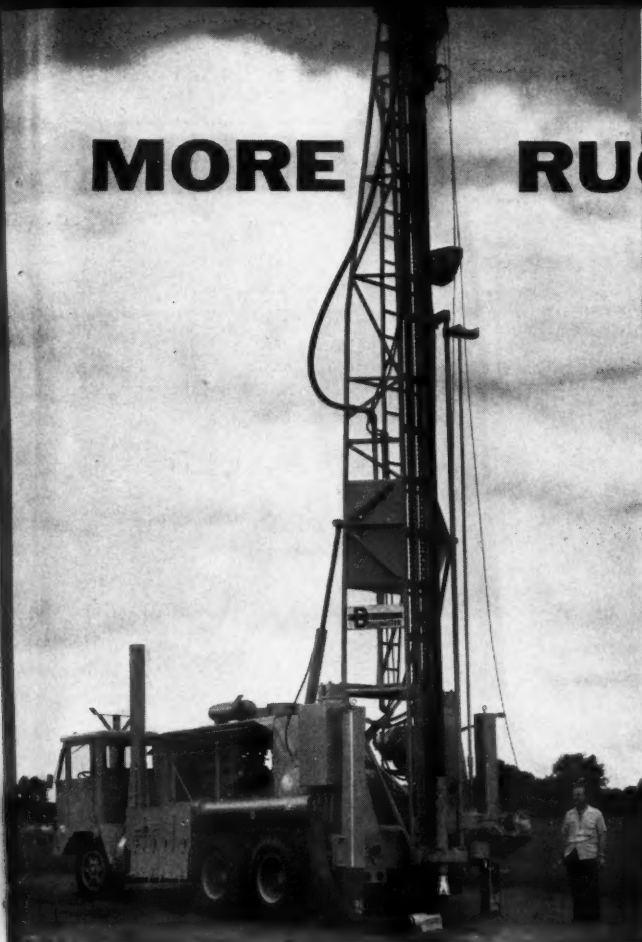
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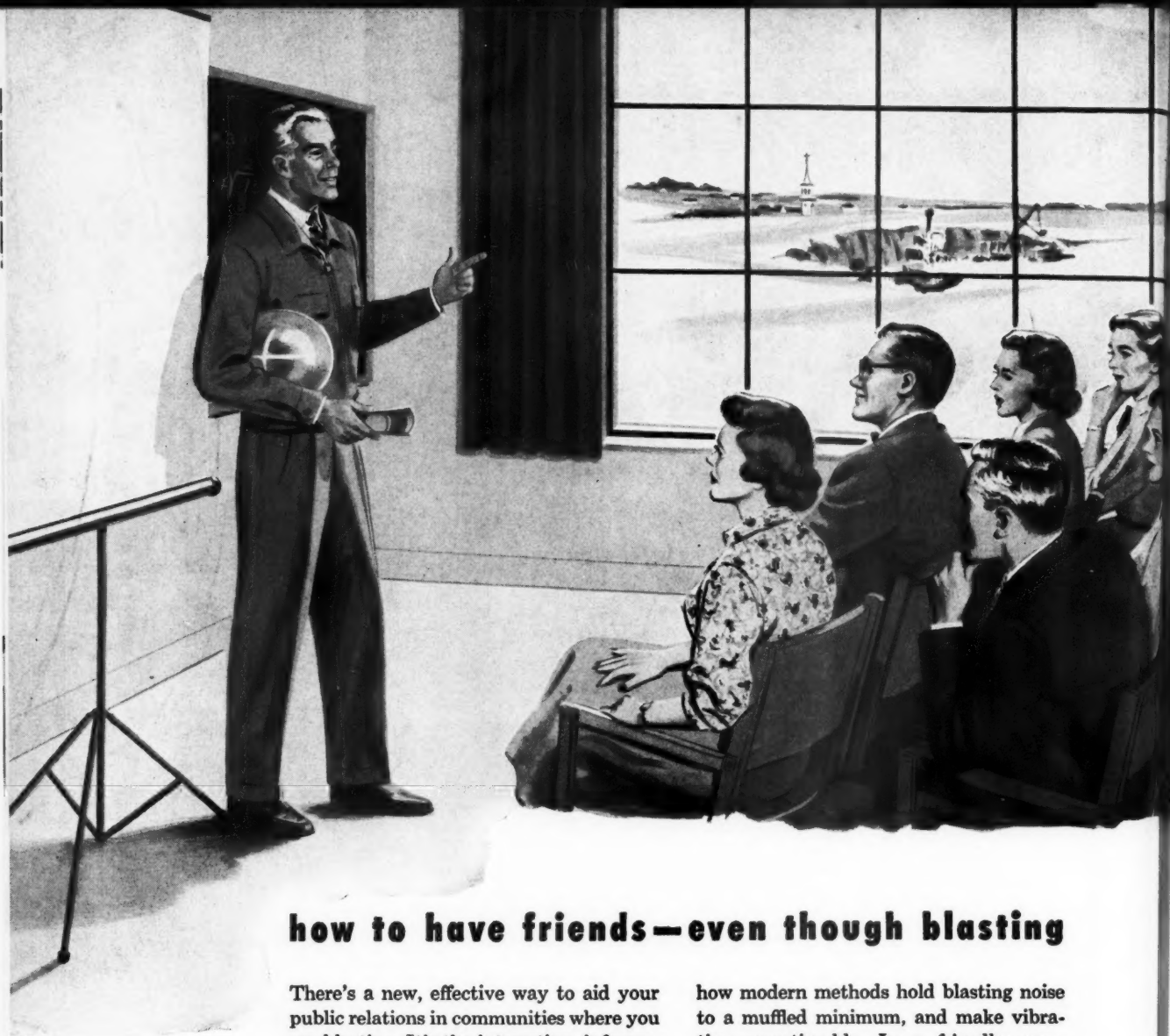


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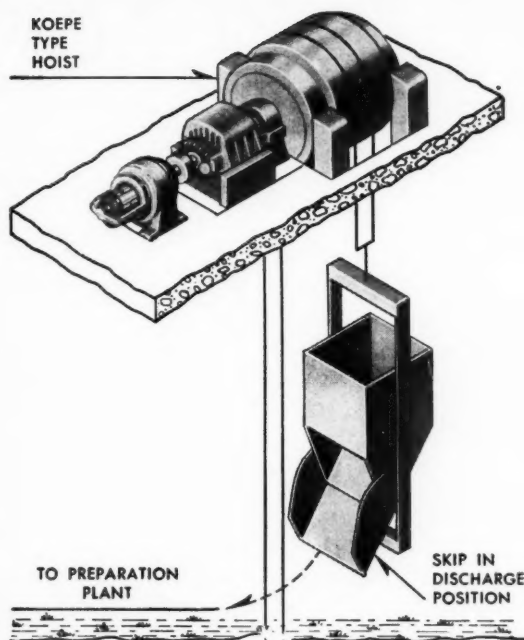
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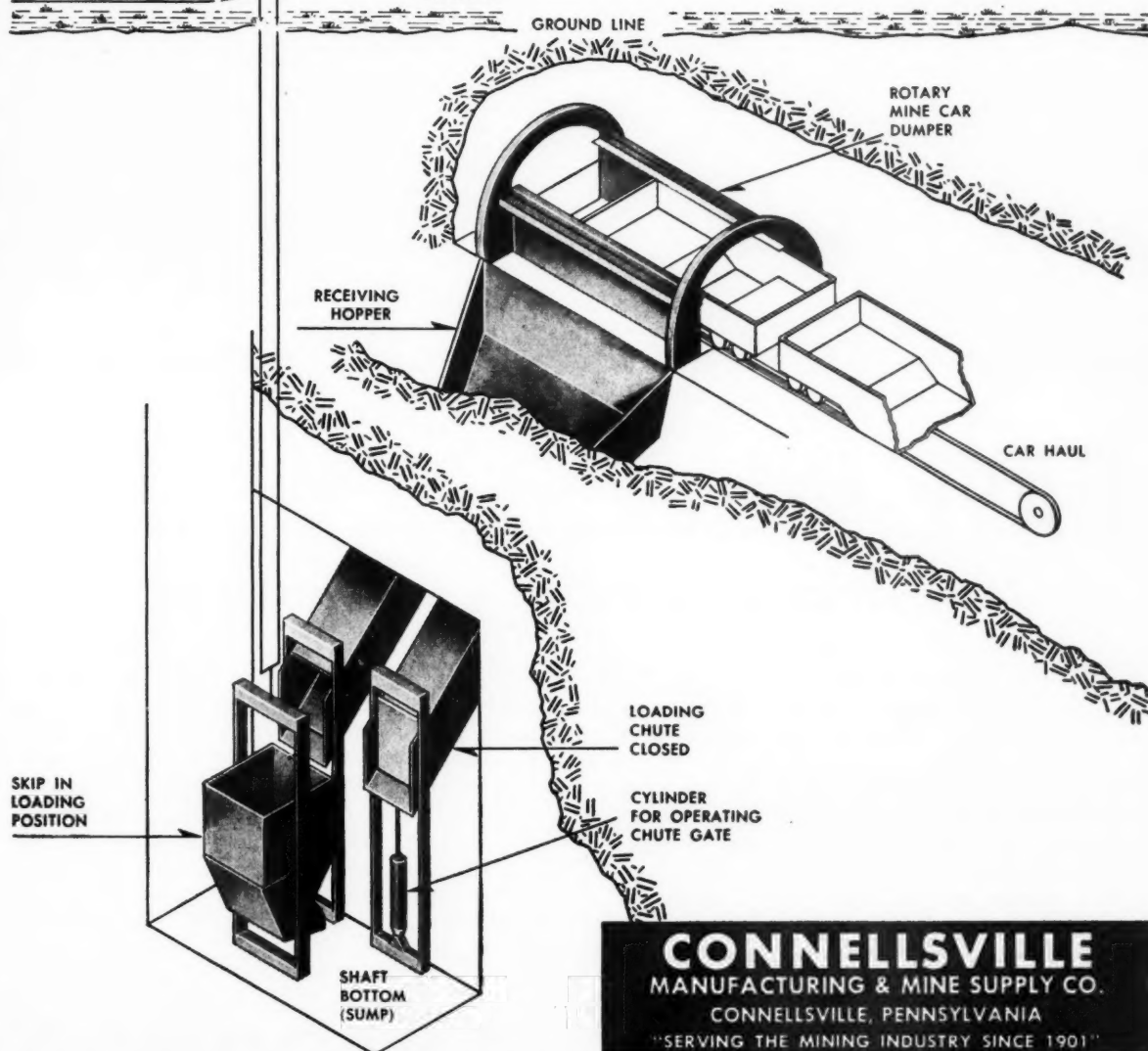
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EDITORIALS

ROBERT W. VAN EVERA, Editor

FEBRUARY, 1958

ANOTHER YEAR

MINING CONGRESS JOURNAL is proud to present this annual mining review of the year 1957. On looking through the excellent articles that follow, readers will become aware that it was a year of stark reality—with both highlights and shadows.

Technologically, the industry continued to make great strides in improved methods and in the application of new equipment. The manufacturers serving the mining industry necessarily had to be on their toes; otherwise these advances would not have been possible. On the economic side, definite and serious "soft spots" have appeared which make cost-conscious, highly efficient operations all the more imperative.

Included in this issue are articles covering the important changes in operating techniques across the whole field of mining. Stout's "Underground Mining Progress," Kirk's "Mechanical Coal Mining," Leach's "Open Pit Mining," Weiss's "Mineral Dressing," Shenon's "Geology in Mining," Utterback's "Strip Mining of Coal," and Joslin's "Coal Preparation" describe new developments that every mining man should study. The nature of the "breakthroughs" that are discussed varied broadly from district to district. Since in each mining area there are phases of operation that are parallel in some degree with those in other areas, there is great value in finding out what's going on at the other fellow's job.

Other specialized subjects such as Safety, Coal Economics, Strategic Minerals, Mine Equipment Sales and Research give data on some of the most important aspects of mining. These are matters on which most mining men find it difficult to keep themselves informed in the course of their regular chores. And, since each subject is presented here without unnecessary detail, these articles are particularly valuable to the miner in the field.

A major feature of this review issue, of course, is a series of articles dealing with the various individual commodities produced by the mining industry.

In each category there was more competition in 1957—and evidence that this trend will continue. While costs of labor, supplies and equipment continued to rise last year, prices for mineral products, in most cases, either held about steady, or went down. And in the cases of copper, lead and zinc the price drops have crippled a large segment of the industry. In other branches of mining, where in the past there has been a shortage of production—for instance, nickel, aluminum, iron ore, cement and titanium—1957 marks the year when that shortage was elimi-

nated. But, characteristically, producers of these materials are doing all they can to meet present conditions head-on and to prepare for stiffer competition in the future.

The coal industry already knows all too well what it means to lose markets during a period of rising costs, and has done a magnificent job of stabilizing itself by better marketing and more streamlined operations.

The uranium industry, with but little hindsight on which to base its expansion, has "come of age" and is continuing to grow, but it is doing so with caution. Gold, silver, phosphate, potash, sulphur and molybdenum, have all had their own problems; and in solving them—or working toward solutions—the producers have contributed to the industry's progress.

Authors for this issue were picked for their broad gauge and their proven ability to gather and evaluate the most significant data on their subjects. We would advise younger mining men to emulate these authors, who are "pros" of extraordinary attainment. They are essentially men who have had to "get down and dig," but at the same time they kept their heads up and their eyes open.

The industry has a right to feel a deep sense of satisfaction for a job well done in 1957, but there is no time to bask in this glory. Serious problems still remain and must be solved.

TRUCKS AND UNLIMITED PROGRESS

TRUCK manufacturers have built, tested, and now have on the market tractor-trailer trucks of the 80-ton payload class. These have been designed principally for use in the coal industry.

We recently had occasion to discuss truck design problems with one of the leaders among the truck manufacturers—a man who, for many years, has been under pressure to meet the demands of strip and open-pit mine operation.

It is apparent that the development of such huge trucks is dependent upon "breakthroughs" in many fields. Inadequate tires were once the limiting factor. Until torque converters were greatly improved the drive-line was a stumbling block. Lightweight chassis and bodies have made larger payloads possible. Before the 80-ton units could be built there were a number of axle and tandem-drive problems that had to be licked.

Difficulties in designing efficient and trouble-free engines of extremely high horsepower are reported to be the present bottleneck, but we are confident that with concentrated effort to these problems, engine manufacturers will solve them.

Now the miner comes into the picture. To use these larger trucks he must have a mineral deposit and mining plan that can benefit from larger haulage units—and pay for them. In many cases the equipment with which these trucks are used has to be increased in size proportionately—particularly the loading unit.

Before one of these major "breakthroughs" can become a reality, a staggering amount of basic engineering is necessary. Yet each advance opens new avenues to be explored for future development. There is no limit to progress.

Progress in Health and Safety

In the Mining Industry

By MARLING J. ANKENY

Director, U. S. Bureau of Mines

An eminent Government official notes favorable trend in injury-frequency rates during the last five years as he describes efforts of labor, management, machinery manufacturers, State and Federal agencies and others to better mining's safety record

ACCURATE analysis of the injury records in the mining industries is not possible so soon after the close of 1957. Significant improvement, however, is noted by maintenance of a favorable trend in injury-frequency rates during the last five years, but because of five major disasters in the coal mining industry, the final record for 1957 probably will not equal the overall injury record for 1956. Notable advances in safety have been made in all the mining industries but the full effects of these may not be felt until some time in the future.

The injury records of the coal, metal and nonmetal mining industries have improved during the past five years. For example, since records of coal mine injuries have been kept, 1953 was the first year during which the overall frequency rate (fatal and nonfatal) was less than 50 lost-time injuries per million man hours of exposure. With respect to the metal and nonmetal mining industries, 1951 was the first year during which the combined injury-frequency rate was below 45 per million man-hours. In each instance, the frequency rates did not revert to their former levels. Despite a temporary setback, the mining industries are maintaining a favorable trend in injury rates, but they have no reason for complacency because the injury rates are still much too

high compared with those of most of the major industries in the United States.

Table 1 shows the record of fatal and nonfatal injuries in the coal mines in the United States from 1952 to 1956, inclusive. This table gives the numerical injuries for those years but does not tell the entire story without table 2, which gives the injury-frequency rates based on million man hours of exposure. Table 2 discloses that the best injury-frequency record for the coal mining industry was attained in 1955, when the rate was 46.57 injuries per million man hours of exposure.

Similar injury data have been assembled for 1952 to 1956, inclusive, covering metal mines, nonmetal mines (other than coal), metal and nonmetal mines combined, and quarries. Table 3 shows the fatal and nonfatal injuries and table 4 the frequency

rates. With respect to the number of injuries and frequency rates in each category, 1956 was the best year for the metal and nonmetal mining industries. It should be emphasized that although not uniformly downward the injury-frequency rates for the metal and nonmetal (other than coal) mining industries have maintained a favorable trend. This fact should encourage these industries to do even better in the future.

Table 5 shows comparable rates of injury in the main classifications of mining in the United States. On the basis of frequency of injury per million man hours of employment, Pennsylvania anthracite mines are the most hazardous. These are followed in order by bituminous coal (including lignite) mines, metal mines, nonmetal mines, and quarries. Inasmuch as quarries represent primarily open-pit work, the injury-frequency records

TABLE 1.
Coal mine fatal and nonfatal injuries, 1952-56¹

Year	Bituminous coal ²		Anthracite		Total	
	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal
1956	389	15,822	56	3,257	445	19,079
1955	357	16,117	60	2,885	417	19,002
1954	334	14,746	62	2,972	396	17,718
1953	397	20,112	64	4,146	461	24,258
1952	449	23,719	99	6,355	548	30,074

¹ 1955 and 1956 show preliminary data.
² Includes lignite.

TABLE 2.
Coal mine injury-frequency rates,¹ 1952-56²

Year	Bituminous coal ³			Anthracite			All coal		
	Fatal	Nonfatal	Total	Fatal	Nonfatal	Total	Fatal	Nonfatal	Total
1956	1.08	44.10	45.18	1.22	70.91	72.13	1.10	47.14	48.24
1955	0.95	43.04	43.99	1.41	67.76	69.17	1.00	45.57	46.57
1954	0.99	43.66	44.65	1.23	59.18	60.41	1.02	45.67	46.69
1953	0.89	45.26	46.15	0.92	59.85	60.77	0.90	47.23	48.13
1952	0.90	47.64	48.54	1.03	66.35	67.38	0.92	50.66	51.58

¹ Per million manhours of exposure.
² 1955 and 1956 show preliminary data.
³ Includes lignite.

A graduate of the College of Engineering, Carnegie Institute of Technology, Marling J. Ankeny began his employment in mines in 1920. He worked as a



general mine laborer, mine surveyor, fire boss and mine foreman in western Pennsylvania coal mines. Later he became safety director for the National Mining Co. of the U. S. Steel Corp. at Morgan, Pa.

In 1928 Ankeny joined the Bureau of Mines at Pittsburgh as a safety worker. His career with the Bureau found him participating in many projects concerning the metal mining industry and its operational problems. He also drew frequent assignments in recovery and investigative work following mine explosions. From 1941 until 1952, with the exception of two years as a Navy officer during World War II, Ankeny was closely associated with Federal inspection of coal mines and in his last four years directed all such safety work for the Bureau with headquarters in Washington, D. C.

He left the Bureau in 1952 to become safety director for the Bituminous Coal Operators' Association, but returned in 1956 to become the tenth Director of the Bureau of Mines.

of the quarry industry are not directly comparable to coal, metal, and nonmetal mining, which represent predominantly underground work. The five year injury-frequency record for the three industries combined ranged from 49.41 in 1952 to 44.71 in 1956, with an all-time low of 44.09 attained in 1954. The reason that the

record of the coal mining industry has such a marked effect upon the overall injury record of the mining industries as a whole is that the man hours of employment in the coal mining industry are more than 2½ times as much as those in the metal and nonmetal mining industries combined.

Major Disasters

During 1957 the coal mining industry suffered four major-explosion disasters, and one major disaster caused by a "bump." The Bureau defines a major disaster as a single catastrophe in which five or more persons are killed. All five disasters were in bituminous coal mines and each of the four explosions resulted from an ignition of explosive gas.

The first major disaster of 1957, a gas explosion caused by using permissible explosives in a nonpermissible manner, occurred on January 18 in Alaska. Five men were killed. The mine was not properly rock dusted, and the explosion traversed the entire mine. Only five men were in the mine at the time, the only reason that the total killed was so small. The second major disaster occurred in southern West Virginia on February 4. The explosion was initiated by the arcing or sparking of electrical equipment that ignited explosive gas presumed to have accumulated through an interruption to the normal mine ventilation. Thirty-seven men were

killed but the mine was well rock dusted and the forces of the explosion were confined to a comparatively small area of the mine. The third major disaster occurred in a Pennsylvania bituminous coal mine on September 23. Six men were killed, five of whom were officials. Gas accumulated while the ventilating system was disrupted because of failure of a main fan. The source of ignition was the arcing of the trolley of a "jeep" or arcing of a cut-out switch. This mine was well rock dusted, and the violence was confined to a relatively small area. The fourth major disaster occurred in a West Virginia coal mine on December 9. Five men were killed by a cave-in caused by a mountain bump. The fifth major disaster, killing eleven men, occurred on December 27 in a West Virginia coal mine and was caused by an ignition of explosive gas.

The last major disaster before January 18, 1957, occurred 796 days previously on November 13, 1954. This major disaster-free period, however, lacked eight days of breaking the record, extending from November 4, 1948, to January 18, 1951—a period of 804 days.

Gas Ignitions and Fires

In addition to the four gas ignitions resulting in major disasters, the Bureau of Mines has reports of 21 other underground gas ignitions in which a total of seven workmen lost their lives. All of these ignitions were confined to relatively small areas indicating the effectiveness of rock dusting in preventing widespread explosion, notably in bituminous coal mines.

During the year 56 underground coal mine fires occurred, most of which were of electrical origin mainly from overheated trailing cables. Another principal cause was from

TABLE 3.

Metal and nonmetal mines and quarries, fatal and nonfatal injuries, 1952-56¹

Year	Metal		Nonmetal		Metal and nonmetal		Quarries	
	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal	Fatal	Nonfatal
1956	67	4,443	14	915	81	5,358	49	3,701
1955	79	5,795	18	1,155	97	6,950	53	3,778
1954	86	4,994	9	956	95	5,950	34	3,834
1953	92	6,164	22	1,419	114	7,583	43	4,450
1952	117	6,684	14	1,171	131	7,855	74	4,503

¹ 1955 and 1956 show preliminary data.

TABLE 4.

Metal and nonmetal mines and quarries, injury-frequency rates,¹ 1952-56²

Year	Metal			Nonmetal			Metal and nonmetal			Quarries		
	Fatal	Nonfatal	Total	Fatal	Nonfatal	Total	Fatal	Nonfatal	Total	Fatal	Nonfatal	Total
1956	0.55	36.64	37.19	0.43	28.28	28.71	0.53	34.88	35.41	0.28	21.10	21.38
1955	0.60	43.80	44.40	0.61	38.85	39.46	0.60	42.89	43.49	0.31	22.12	22.43
1954	0.66	38.27	38.93	0.30	32.34	32.64	0.59	37.18	37.77	0.19	21.81	22.00
1953	0.59	39.36	39.95	0.72	46.54	47.26	0.61	40.53	41.14	0.23	23.45	23.68
1952	0.74	42.13	42.87	0.48	40.44	40.92	0.70	41.87	42.57	0.40	24.14	24.54

¹ Per million manhours of exposure.

² 1955 and 1956 show preliminary data.

TABLE 5.

Total injury-frequency rates,¹ mines and quarries, 1952-56²

Year	Bituminous coal ³		All coal	Metal	Nonmetal	Metal and nonmetal		Quarries
	Fatal	Nonfatal				Fatal	Nonfatal	
1956	45.18	72.13	48.24	37.19	28.71	35.41	21.38	
1955	43.99	69.17	46.57	44.40	39.46	43.49	22.43	
1954	44.65	60.41	46.69	38.93	32.64	37.77	22.00	
1953	46.15	60.77	48.13	39.95	47.26	41.14	23.68	
1952	48.54	67.38	51.58	42.87	40.92	42.57	24.54	

¹ Per million manhours of exposure.

² 1955 and 1956 show preliminary data.

³ Includes lignite.

burning conveyor belts, but this source is diminishing since the introduction of fire-resistant conveyor belts during the latter part of 1955. While only two fatalities resulted from the fires, their prevalence indicates that stricter fire-prevention safeguards are necessary.

While a total of nine fatalities involved in more than 75 gas ignitions and fires may not seem large, the dangerous potentialities should be emphasized. Wet rock dusting in ad-

The best safety device is a safe workman



vance work and the prompt use of fire-fighting equipment, coupled with good generalized rock dusting, probably explains why the number of fatalities was so low in these occurrences. The fact that so many of them occurred during 1957 indicates that gas testing should be done more frequently and thoroughly and the sources of ignition for gas as well as for fires should be eliminated.

Control of Mine Explosions and Fires

When approaching close enough to apply quenching and cooling agents in attacking coal mine fires, fire fighters occasionally encounter great difficulty due to roof falls, heat, and smoke. Research work was initiated in the Bureau's Experimental Coal Mine on the generation of high-expansion air foams (expansion ratio, 1000: 1), their transport by the mine-ventilating current, and their effectiveness in quenching fires. This method was originally tried on timber fires in a British experimental tunnel. On reaching the fire zone, the foam partly blankets the fire and thereby tends to exclude oxygen, cools the fire by virtue of the latent heat of vaporization of the water, and reduces the oxygen content in the fire area due to the water vapor formed by evaporation of the water. The combined effect is to stop flaming combustion and to reduce the temperature in the fire zone on the approach side of the fire enough to enable fire fighters to come within fighting range and attack the fire with large volumes of water or by other standard methods.

Wet rock dusting near rapidly advancing coal faces was extended to additional highly mechanized mines. The effectiveness of this form of rock

dusting in arresting coal-dust explosions had been proved by a series of tests in the Experimental Coal Mine.

The rate of deposition of finely divided, fresh float coal dust on the surfaces of mine entries has an important bearing on the frequency of re-rockdusting. The factors that govern the transport of float dust by the ventilating current are now being studied.

In 1957 renewed interest was manifested in the possibility of promoting the agglomeration of coal dust particles by inducing their adherence to the rib and roof surfaces in mines instead of being dispersed and possibly taking part in an explosion. Several adhesive compounds, which can be sprayed on the mine surfaces, were studied to determine their effectiveness.

Laboratory and mine studies are in progress in Germany and in England on trapping and neutralizing coal dust by spraying saturated sodium chloride salt solution and by applying calcium chloride paste on the surface of mine entries. These studies are being followed with interest in the United States, although in its present state of development the sodium chloride

process is not suitable for application in mine atmospheres of high relative humidities.

Ventilation and Dust Control

The importance of ventilation was emphasized as the first line of defense against hazards to health and safety. The major coal mine explosion disasters that occurred in the United States in February and September were directly influenced by failure of the ventilating systems. These occurrences forcefully illustrate the hazards of interrupted ventilation, particularly when doors are used to control main ventilating currents, and the hazards accompanying reversed airflow when one or two or more ventilation fans operating in combination stop. The two major-explosion disasters renewed activity to eliminate the use of doors as far as possible and prompted a study to determine the effect of using two or more fans in combination.

The coal mining industry, machinery manufacturers, and the Bureau of Mines cooperated in a study of how to ventilate working faces properly when continuous mining machines are operated. Information obtained in the field indicates that continuous mining machines can be adequately ventilated by means of auxiliary fans and tubing. As a result, several experimental installations were made in coal mines to determine the safety and effectiveness of such auxiliaries.

The practice of drilling and utilizing large diameter boreholes (to 48 in.) as auxiliary ventilation shafts to drain gob areas in coal mines or serve as intakes to isolated working sections gained favor during 1957. The results indicate that such boreholes can improve the ventilating efficiency of large mines.

The American Mining Congress continued to study the problem of controlling coal dust produced by continuous mining machines and gathered practical information on the use of water sprays for this purpose. The rapid rate of extraction of coal with continuous mining machines makes dust control an important matter. The dust-control problem is



The mining industry has made steady gains in reducing the accident hazard in all kinds of mines



Rate of deposition of finely divided, fresh float coal dust on the surfaces of mine entries has an important bearing on the frequency of re-rockdusting. Factors that govern the transport of float dust by the ventilating current are now being studied

threefold—dust restricts visibility at the face, combustible dust is deposited in return airways, which requires neutralization with rock dust, and workers may be exposed to the potential health hazard of airborne dust.

National Campaign to Prevent Roof-Fall Injuries

The pattern of fatalities from falls of roof and ground continued about the same as has prevailed over the years. Ordinarily, 1/2 to 2/3 of all coal mine fatalities occur from falls of roof. In metal and nonmetal mines (other than coal) the term "falls of ground" is synonymous with falls of roof, and in such mines about a third—the largest single cause—of the fatal underground injuries result from this source. Falls of roof or falls of ground, as the case may be, also cause the largest number of serious nonfatal injuries.

To prevent roof-fall accidents in coal mines, the National Safety Council, in cooperation with major coal associations and the United Mine Workers of America, is sponsoring a campaign, which was begun on July 1, 1957, and is to end on June 30, 1958. This effort was stimulated by a similar 12-month campaign by the National Safety Council, begun July 1, 1955, to prevent falls of ground in the metal and nonmetal mines of the United States and Canada. That campaign was highly successful, and the good effects are continuing. The objective of the 1957 campaign in coal mines is to reduce fatalities and injuries 50 percent. Virtually all safety-minded agencies identified with the coal mining industry in the United States are cooperating, and approximately 1200 coal mines are enrolled in it. Appropriate awards will be given to mines, companies, supervisors, and workmen who reach the objective. It is too early to predict the overall success of the National campaign after only six months, considering the

"lag" in collecting and assembling records. The Bureau of Mines is cooperating by asking the Federal inspectors to discuss roof-support plans with individual workmen, supervisors, and management officials of coal mines to develop a thorough understanding of the plan of minimum roof support for each mine. Moreover, the Bureau is conducting roof-control surveys to cover both roof bolting and conventional timbering practices, particularly in mines where the roof is difficult to support, and suggesting improvement in the practices.

Roof Control Activities

Roof bolting in coal mines—rock bolting in other mines—had been practiced to a limited extent during the quarter century preceding 1950. Its use for roof or back support was extended in 1949, and since then it has been widely adopted in mines and tunnel excavations.

Roof or rock bolting is now practiced in approximately 1000 mines (780 coal and 220 noncoal, estimated). About 4 million bolts a month were installed for roof or back support during 1957. It is estimated that more than 200 million bolts have been installed in mines of the United States; nevertheless, the bolting systems are adopted largely by "trial and error." Because of the variable characteristics of roof rock, it is difficult to reduce roof control to an exact science. Recognizing the imponderables, roof-control specialists of the Bureau of Mines withhold approval of any bolting method unless it has been thoroughly tested as an experimental installation in which the bolting is supplemented by the conventional timbering, both as to plan and quantity, that it is intended to replace.

Roof or rock bolting is no "sure cure to the ills" of roof or back because sometimes it will not be suitable. Where the roof can be stabilized with bolting, it has many advantages,

especially where mechanical loading or continuous mining is adopted.

In some instances ordinary roof bolting may not produce a competent beam or roof because of laminations, cleavage planes or joints of weakness in the strata. During 1957 considerable experimentation was conducted by injecting liquid substances into coal mine roof rock, which solidify rapidly to cement the roof strata. Promising results have been obtained in solidifying such roof so that the effect of using such substances might supplement roof bolting or possibly replace it in a few mines. The Bureau of Mines will continue these investigations and has established a Roof Control Research group to consolidate all roof-study activities under one direction.

Inasmuch as most roof-fall accidents occur within 25 ft of the face, the problem of satisfactory temporary support in this area is one of first magnitude. Limited work on shields or other artificial overhead protection has been done in the past, but in 1957 effort was intensified to produce an effective, workable shield to protect workmen at the face until permanent supports can be installed.

Developments in Explosives and Blasting

In recent years the Bureau of Mines has encouraged explosives manufacturers to modify certain brands of permissible explosives to improve the margin of safety. The desirability of this has been accepted by several manufacturers, and a number of explosives were modified in 1957. During the year the compositions of several brands of explosives were significantly modified by one explosives manufacturer to make them safer for use in underground coal mines, without sacrificing nominal power and performance characteristics. It is believed that this development presages a trend that may be followed throughout the industry. At the same time, the Bureau of Mines has accelerated its program of research and tests on permissible explosives in an attempt to define more accurately those factors responsible for the ignition of explosive gas or coal dust by explosives, when the explosives are used improperly.

For many years stemming devices, which were approved by the Bureau of Mines, have been used in a number of coal mines in potentially explosive atmospheres. A complaint about these plugs has been the hazard from flying plug fragments when the explosive shot was fired. In addition to overcoming this objection, during 1957 the Bureau of Mines developed a new schedule for the approval of permissible stemming devices. One new stemming plug has been approved un-

der the provisions of this new schedule.

The Bureau devoted considerable attention to the problem of multiple blasting in coal mines with millisecond-delay detonators. Roof-fall injuries at the face cause the greatest number of fatal and serious nonfatal accidents in underground mining. Many of these accidents occur when the workman returns to the face after a shot to load, stem and hook up subsequent shots. In trying to maintain production, often inadequate attention is given to the safety of the roof, and fall-of-roof injuries result. The Bureau's study has resulted in the preparation of a new schedule developed for testing blasting units of adequate capacity to insure the safe firing of millisecond-delay detonators in rounds up to ten shots. Such firing will cause less shock to the roof and thus will reduce the fall-of-roof hazard. Moreover, the electric current to the blasting unit is cut off in time to avoid the hazard of arcs on the firing line, and more energy is supplied than with older units, which should virtually eliminate misfires.

During 1957 liquid oxygen explosives were being replaced by field-mixed explosives based on ammonium nitrate in open-cut (strip pit) coal mines. The latter explosives, while designed to effect economies in blasting, may also increase safety by virtue of their insensitivity. Such explosives are also being used widely in open-cut metal and nonmetal mines and quarries and construction projects in place of conventional dynamite.

Electrical Mechanical Developments

The first explosion-proof lamp using flash bulbs for underground photography was approved as permissible in 1957. The lamp is entirely self contained, including batteries, and additional lamps can be fired by means of a photocell without requiring electric cords to connect lamp to lamp. The firing circuit is intrinsically safe, so that a switch on any camera may be used.

Two additional general mine-lighting fluorescent systems were approved during the year. One type was the conventional three-wire grounded system and the other a two-wire ungrounded isolated system. Previously approved general fluorescent mine-lighting systems were installed in operating coal mines. This improvement in illumination in face areas is expected to grow in the near future and undoubtedly will contribute substantially toward the reduction of accidents by permitting workmen to see dangers better and take steps to avoid them.

Increased interest was manifested in the diesel field for various types of machines used in mines other than coal. Three additional diesel ap-

provals were issued during the year for noncoal mining equipment.

To indicate the increasing use of permissible mining equipment, over 140 permissibility approvals were issued by the Bureau during 1957 for various kinds of electrical-mechanical equipment.

An important project begun in 1957 was undertaken to develop a safe, reliable, inexpensive, methane alarm that is so urgently needed in conjunction with mechanized mining, particularly continuous miners. A reliable continuous alarm would eliminate the gas-ignition hazard by interlocking it with the power system so that when a predetermined percentage of methane accumulates the power to mining equipment within the controlled area would be cut off automatically.

An interesting industrial development during the year was the manufacture of several plastic-covered cables that were constructed to be both flame resistant and damage resistant. These successfully met Bureau requirements and were given rigid field tests under day-to-day mining conditions. Such cables are designed to minimize mine-fire and gas-ignition hazards from overheated or damaged trailing cables.

A problem of first magnitude in any continuous mining operation is how to protect the operator who is exposed to the hazards of roof, gas and dust near the face. The most satisfactory way of minimizing the hazard is to remove the operator from the immediate face area by substituting remote control. Late in 1957 a study was begun on remote-controlled circuits for a continuous mining machine to enable the operator to control the machine from 50 to as much as 350 ft behind the machine. By so doing he will not work under unprotected roof; indicating lights will tell him the position of the cutting heads and also the position for tramming. Moreover, the strain on the cutters will be discernible through indicators at the remote-control station, so the operator will know whether the machine is cutting in coal or other material.

Environmental Health Studies

The Bureau of Mines, in cooperation with the U. S. Public Health Service, took steps to institute environmental studies in metal and nonmetal mines. The purpose of such studies is to determine the incidence of silicosis among workers, where dust concentrations occur and what control measures are in effect, the extent of free silica in airborne dust, and the particle size distribution of airborne dust. The Bureau of Mines will be responsible for the environmental aspects of the field studies, whereas the Public Health Service will have charge of the clinical aspects.

Upon requests from users and man-

ufacturers of respiratory-protective devices, the Bureau of Mines agreed to broaden its respirator approval system to include radioactive aerosol respirators. An advisory committee on respiratory protection against radioactive materials was organized to consult with Bureau of Mines personnel on the development of acceptable standards for testing and approving respirators designed to protect against radioactive aerosols.

Interest in the study of health hazards to workmen in underground uranium ore mines was renewed by cooperative effort of the health departments of several western states, the U. S. Public Health Service, and the Bureau of Mines. Such hazards stem from radioactive gas and dust. As adequate ventilation is the most practicable means of controlling radon gas and its radioactive decay products, recommendations for ventilation requirements and means for evaluating the radioactivity of underground atmospheres were developed and publicized.

Safety Education

It has been said many times that the best safety device is a safe workman. The author does not think that he can improve on this statement. Eighty percent of industrial injuries are attributed to human failure and 20 percent to mechanical failure. The human element is the more difficult to predict or control; therefore the Bureau of Mines has long held the position that the most effective weapon against the occurrence of accidents and injuries in the mining industries is through safety education. During 1957 the Bureau continued its educational efforts by presenting its accident-prevention courses on or near the mine or plant premises for workmen and supervisors. Accident-prevention classes were held for all kinds of mine workmen—coal, metal and nonmetal. More than 200,000 workmen and supervisors have completed the Bureau's various accident-prevention courses. These, however, do not include the Bureau's training in first aid and mine rescue. More than 1.9 million persons have completed the first aid course and over 110,000 the mine rescue course. Accident-prevention education is most effective when both workmen and their supervisors take instruction together, and best results are obtained when a mine or plant has 100 percent employee participation.

The mining industries still have a long way to go before their accident records will compare favorably with most other major American industries but progress has been made, and the trend is in the right direction. By united effort of labor, management, and all agencies interested in safety, continued improvement can be expected in the years ahead.

Underground Metal Mining Progress

As a result of current low metal prices the need for cost-cutting innovations in underground mining is greater than ever

By KOEHLER STOUT

Assistant Professor of Mining Engineering,
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THE year 1957 marked a reversal in the recent trend for large demands of the base metals. Copper prices reached a new current low, the prices for lead and zinc stayed at a low level, and the government subsidy program on tungsten was withdrawn for lack of funds, which forced many underground mines to either curtail or suspend operations because of the cost of operation.

Now, perhaps more than ever before in the post-Korean War years, operators of underground mines are forced to drastically cut costs per unit

of ore mined if their operations are to survive. The progress review this year primarily indicates how operators are effectively combating these adverse conditions with continual progress in improving the efficiency of their operation.

Shaft Sinking

Sinking shafts is still one of the most costly and slowest phases of underground operations. The problem has received much study, especially by mine operators in South Africa, whose efforts have produced some

amazing shaft-sinking records. Sinking rates of 500 ft per month are commonly attained, and some operators feel that they can eventually reach rates of 1000 ft per month. Rates of progress in sinking on the North American continent are much slower than those attained by the South African operators.

Several years ago, South African operators developed the Galloway stage, upon which they have since been improving. This stage is commonly a three-deck apparatus, from which simultaneous operations such as mucking or drilling, and concreting or lining can be carried on. The Africans use large, air-operated, mechanical grabs for mucking into large-capacity sinking buckets, hoisted in counterbalance through especially designed crossheads sliding on rope guides. Commonly, the shafts are circular in cross section, with diameters of approximately 20 ft. As some American companies have expressed an interest in this method, undoubtedly the system will see use in the United States in the near future.

Shafts of circular cross section are becoming more prevalent in North America, although rectangular sections are still popular. Concreted walls with steel dividers are often used for shaft support and spacing. Mechanical mucking machines frequently employed are the Riddell mucker, the hydro mucker, the Cryderman mucker, and (in large cross-sectioned shafts) the Eimco 630 crawler-mounted loader. In rectangular shafts, with mechanical mucking equipment, the old system of benching is commonly used. This procedure, by throwing the muck to one end has some advantages. It provides for easy loading, produces a low side to act as a sump, provides a breaking face for



The Zeni shaft-drilling machine resembles the old calyx drill, except that the core barrel is fitted with rolling cutters similar to those of rotary bits used in oil-well drilling

the drill holes, and relieves the necessity of drilling under water. The Cryderman mucker has been successfully adapted to mucking in steep-inclined shafts; it is in current usage in the Coeur d'Alene district in Idaho.

Drilled or bored shafts are common in the United States. The Zeni shaft-drilling machine has successfully completed many shafts in the Virginia and West Virginia coal fields, and its use is expanding into other regions. In form, this machine resembles the old calyx drill, except that the core barrel is fitted with rolling cutters similar to those of rotary bits used in the oil-well drilling industry. At their Young mine near New Market, Tenn., the American Zinc Co. successfully drilled a 66-in.-diameter ventilation shaft with a Calyx drill. For a number of years, smaller diameter holes have been successfully drilled by Calyx methods in the uranium fields in the United States.

Prior to continued sinking operations, American companies have, by pre-drilling and pressure grouting, been successful in sinking through water-bearing formations. Freezing the area before shaft sinking has also proved successful in Canada.

A novel method of blocking steel-shaft sets firmly in place was used at the Ore Knob mine in North Carolina. Burlap bags, filled with dry grout and held in place on top of steel pins emplaced in the shaft walls, were packed around steel-shaft sets. As the bags took up moisture, the grout hardened around the sets, holding them firmly in place. Another novel idea was that an electrically wired hoisting rope, to provide positive power for the shaft signaling system, was successfully used at the Galena Mine, near Wallace, Idaho.

Drilling and Blasting

This past year, improvements noted in drilling machines consist mostly of normal engineering design types. Jumbo-drill carriages are becoming bigger, with the trend toward central controls, so that one or two men can operate two or more drills at one time. The positioning of the machines is commonly done by air and hydraulic pistons or motors. Air-leg drills remain favorites in many operations. The trend in these and other hand-held machines being toward lighter weight in construction, more convenient location of controls, and more foolproof operation.

Tungsten-carbide bits find wide usage in almost all types of ground. Under continual study is the problem of attaching the bit to the rod, and now most bit manufacturers have at least one style of taper-socket connection, in addition to threaded connections. Integral carbide inserts in the drill steel are still being employed at many mines. Improvements in the

Koehler Stout received his professional schooling at the Montana School of Mines. After an interruption of



three years of overseas service in the U. S. Army Ordnance Corps, he completed the Mining Engineering course and earned his Masters in Geological Engineering. After working on various jobs in industry — from construction worker to mine engineer and mine captain — he returned to his alma mater in his present position. During his summers Stout serves as Chief of the Mining Division of the Montana Bureau of Mines & Geology at Butte.

metallurgy of drill steel were reported this year as; (1) new types of alloy steel, (2) methods of heat treating (carburization is popular), and (3) spiral rolling of drill rods after working. All of these refinements tend to increase drill-rod life.

Professor E. P. Pfeider and W. D. Lacabanne, of the University of Minnesota, reported on research results obtained with a rotary-percussion drill. The results of these tests are encouraging, and further work may prove this drill effective. These tests noted high penetration rates in soft to medium hard rock.

When conditions permit its use, long-hole drilling with percussion drills, sectional steel, and tungsten-carbide bits is practiced throughout the industry. The Zinc Corp., Ltd., at Broken Hill, Australia, reports the successful drilling with long-hole machines, and blasting of 40-ft winzes from a level above to a stope below. Nineteen parallel holes are drilled (three of them 3-in. in diameter, which are unloaded and used in the cut). Ten ft of raise is blasted at a time; however, the holes are loaded from the top. With varying results, this idea has been tried in the United States.

When diamond drilling, core recovery in broken and fractured ground is often poor. The Christensen Diamond Products Co. reports that a chrome-plated inner tube will increase core recovery in hard, abrasive, broken rock. This company reports that a modified pilot-type core bit, the elimination of the core lifter, and controlled amounts of mud as a fluid, increased core recovery from 50 to 90 percent in the Wyoming Gas Hills area.

Explosive cartridge lengths of 16 in., 18 in., and 24 in. are on the market now. When charging drill holes, these longer sticks decrease loading time. The Hercules Powder Co. now markets millisecond delay caps in 27 delays, ranging from 25 milliseconds for the first delay to 2950 milliseconds for the last delay. These delays

make it possible to fire most development headings with one type of cap.

Ore Handling

Ore-handling methods are under careful scrutiny by mine operators desiring to realize greater efficiency. Crawler-mounted, cast-over types of loaders are becoming increasingly popular, especially with a self-loading string of cars, which are equipped with a slusher and scraper. As the loader fills the hopper car, the scraper drags the muck and fills the other cars. This unit is known as the Whup-d-Whup, Boliden, or Pierce loader.

In room-and-pillar mines, various types of loaders are in service. One operator reports that where conditions permit, the boom-shovel gives the lowest loading cost per unit, whereas the slusher-ramp combination usually results in the highest loading cost per unit. Slusher ramps serve in low places where other types of equipment cannot operate. Highly mobile, rubber-tired loaders give excellent results.

Pacific Coast Borax Co. reported a novel idea which keeps a continuous miner cutting borax in almost constant operation. One shuttle car is kept at the miner at all times which receives the newly mined ore. This causes the car to act in a surge capacity. When another shuttle car appears, the cut ore is transferred from the first to the second car, which does all the hauling to a transfer raise. One car hauling reduces traffic and minimizes delays.

Cleveland-Cliffs Iron Co. was reported to have installed some Herald chain conveyors, operated by 50-hp electric motors, to move caved ore from finger raises and scam drifts to cars. This system replaces scrapers.

Operators have carefully examined track-haulage systems, the result of which has been a trend to larger cars and locomotives, heavier rails, and traffic control by block-signal systems and intercommunication systems between the motormen and dispatchers. Roadbeds are now being carefully laid, drained, and maintained in high-speed haulageways. On its main haulage line, the Tennessee Coal and Iron Co. has installed 90-lb, ARA-A-9020 rail with welded joints, giving smoother operation and improving car wheel and locomotive tire life.

The following methods of handling wet, sticky ore were reported. (1) At the Star Mine, Hecla Mining Co. installed a cam type of dump device, which, when dumping, turns the car body completely over. (2) The Alpine Mine car dumps at a 70° angle, which unloads sticky ore successfully in Canadian and South African mines. (3) The Saunders drop-bottom skip works well when discharging sticky ore in a Witwatersrand gold mine. (4) The Simplicity Engineering Co., of Durand, Mich., announced a vibrating

hopper to load skips rapidly in underground mines.

Self-loading, transporting, and discharging units are used for handling ore when feasible; the most popular type being the Gismo. For mucking cut-and-fill stopes, The Anaconda Co. put a hopper on an Eimco 630. Although successful, the problem of raising the machine to the next floor caused serious operational difficulty. Atlas Copco announced the production of a combination mucking machine, self-propelled, self-unloading ore car mounted on rubber wheels.

Pipe chutes made from concrete or heavy-gauge steel are now in use in mines that employ hydraulic-emplaced fill in their stoping operations. Chutes of this type are usually cheaper than wooden chutes and give better service. The pipe is installed, or the concrete poured, before the fill is introduced. After the fill is emplaced, the chute is held firmly in position.

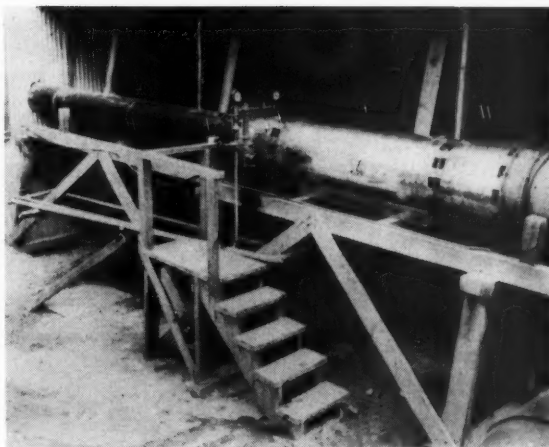
Mining Methods

In development, the most revolutionary item announced this past year is the raise-boring machine made by the Germans. Two of the units described employ roller bits. One style is similar to a reamer bit made by the Hughes Tool Co., whereas the other unit resembles the American Zeni shaft borer. The other unit described uses tungsten-carbide prongs to cut a large core. A preliminary hole must exist so that a towing cable can hold the machine at the face. Boring units have been used to drive level headings also.

In block-caving operations, support is obtained mostly from concrete, rigid steel sets, and yieldable steel sets. Each type works well under certain conditions. Precast-reinforced concrete shaft sets have been successful. For cribbing and lagging, pre-stressed concrete members are in limited use.

In steeply dipping vein mines, cut and hydraulic-fill mining is becoming increasingly popular—in many places replacing other mining systems. Temporary support is gained from rock bolts before the fill is emplaced. The fill is transported to the stope, usually in a slurry ranging in composition from 40 to 70 percent solids. Experimentation is presently trying to determine what type of pipe is best to transport solids. In general, rubber-lined pipes are favored in vertical shafts; whereas on the level, other types of pipes sometimes give satisfactory service. An experiment in Butte was tried using a flocculating agent to consolidate the fill material, but the work done was insufficient to fully evaluate the results.

Filling stopes with dry and slightly moist fill was reported at the Rio Tinto mine in Spain and the Gavarano mine in Italy. In service at Rio Tinto is a pneumatic stower which



The Microdyne dust collector will remove up to 99 percent of all plus five-micron dust particles. The unit pictured is at one of the Anaconda mines at Butte

shoots out 2.8-cu ft slugs of minus 3-in. waste material by sudden discharges of compressed air. At Gavarano there are two systems; (1) a hopper is used in conjunction with an air hose to emplace the fill, and (2) a belt conveyor, equipped with a high-speed head pulley with attached radial blades, throws the fill tightly against the back.

In the uranium mining industry, three mining methods are common: open stoping, room and pillar, and panel retreat. A longwall system, using recoverable steel props to control the cave line, is planned for one mine. Standard Uranium Co. recovers pillars so successfully at the Big Buck mine that it extracts 96.7 percent of the ore. A dragline equipped with a 35-ft boom makes this high recovery possible. The boom is long enough to carry the slusher bucket back under dangerous roof to remove the pillar. The method of pillar blasting is critical for good recovery.

At its mine near Bonanza, Utah, The American Gilsonite Co. announced a new underground mining system. The ore is broken out of steeply dipping veins, up to 22 ft wide, by high-pressure (2000 psi) jets of water directed from a special air-driven, crawler-type cutter car that is equipped with hydraulically controlled booms. The cut ore is flumed away from the face to the shaft, where it is sized and pumped to the surface. Creating a dust-free atmosphere, this system enables production of a high tonnage per man-shift.

Hydraulic transportation is used not only for gilsonite ore, but also for phosphate and coal. Present plans by some operators call for transporting mill products several miles to refineries.

Improvements in design on the U.S. Bureau of Mines experimental, continuous-miner style phosphate planer gave encouraging results. This rubber-tire mounted machine has a plow-shaped cutting edge through which are mounted three large chisel-bit

equipped pavement breakers. As the machine is crowded into the face by a tugger hoist, the spring actuated breakers start when a certain force is applied to them, causing the ore to be chiseled and broken from place. The plow directs the ore into the stope from whence it can be slushed to a chute below.

Other Advances

The Microdyne, a wet inertial dust collector, was introduced on the market by the Joy Manufacturing Co. This machine, originally developed in the Ventilation Department of the Anaconda Company (in Butte) will remove up to 99 percent of all plus five-micron dust particles. The mining industry will undoubtedly find wide application for this machine.

The Koepe hoist installation at the C shaft, Cliff Shaft Mine of the Cleveland-Cliffs Iron Co., was reported to be operating smoothly and fulfilled all expectations.

Of importance to future developments in the mining industry, the symposia on rock mechanics and behaviour of materials in the earth's crust (held at the Colorado School of Mines) and the symposia on drilling and blasting (held at the University of Minnesota) will undoubtedly be beneficial. Attracting wide interest, the ideas expressed at those symposia will become, in part at least, the practice of tomorrow. To be held in May, 1958, a symposium on hydraulic filling of stopes is planned at the Montana School of Mines. This meeting should prove interesting to operators using hydraulic fill or contemplating transportation of slurry through pipe lines.

This compilation of underground metal mining progress is a product of personal contacts with mining operations, of conversations with mining men, and of a review of mining literature published in 1957. The author thanks all of the people, both known and unknown to him, who made this survey possible.

Bituminous Coal

By L. C. CAMPBELL
Consultant, Pittsburgh, Pa.

Coal has moved up alongside
the other industrial giants of
America

A graduate of Penn State University, Luther C. Campbell has been associated with mining for 42 years. He recently retired as vice-president of Eastern Gas & Fuel Associates but plans to remain active in coal mining as a consultant at headquarters which he will open in Pittsburgh, Pa.



Throughout his mining career, Campbell has been active in the mine safety movement. He has played a major role in the many activities of the Coal Division of the American Mining Congress and has been chairman of the Coal Division since 1951. He has also served four terms as president of the National Coal Association and is now NCA director and member of its executive and finance committees. In addition, he is a director of Bituminous Coal Research, Inc., as well as numerous other national and regional engineering and mining groups.

One of his latest undertakings is national chairmanship of a committee to raise financial support to establish a major coal research center in Pittsburgh.

COAL remains the chief source of power in our nation. None of our natural resources has contributed more to the comfort, enjoyment, and development of our social and economic well-being than has this mineral.

There is not space in a short article such as this to outline the almost unbelievable heights to which coal mining has risen. It is sufficient to say that coal and power were one and the same in meeting the needs of the war period. The men who watched the flow of the tools of war, built up through anxious months, knew the meaning of coal production. They knew that the destiny of America was at stake unless there was an adequate supply of this fossil fuel.

Those war needs which were met so well by coal are behind us. Today we live with uneasy peace. Coal production is as vital as it ever was.



America's industrial might stems from coal

The industry has steadily built toward a minimum installed productive capacity of 500,000,000 tons annually. Modernization by all out mechanization has given the industry many large, modernly equipped, well rounded out new production units above and below ground.

There is increasing reason to believe that the Federal and state governments are belatedly assigning coal its rightful place in the national energy needs. Failure to do so is to disarm the nation, should war again come. If the economic life of America is to go on, that is what must be done to maintain the production level of coal needed now, and to be able to increase production with expansion of industry generally as America grows.

The next ten years can well see added strides in production, preparation, and use of this natural resource. The industry has become a well equipped, highly mechanized, material moving industrial giant.

Coal is indeed the raw material of the power, metallurgical, and chemical industries. America, fortunately, is blessed with an abundance of good coals. Her industrial might stems from this fuel. The place of coal in iron metallurgy and power is well

understood. It is now also not difficult to envision gigantic coal conversion plants built astride existing oil and gas lines when the natural sources of oil and gas wane.

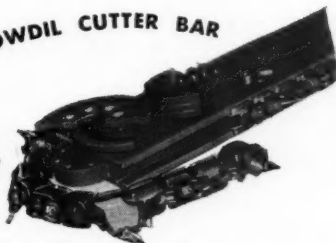
A basic raw material, coal can only be brought to serve the public economy by going underground with men and machinery to win it from its age-old beds. Coal mining is a rugged business, with a challenge to a new generation of miners to further revolutionize the methods of production in the next ten years even more so than has been done in the last ten years.

Coal research will be a big step forward for the industry in the next decade. A centralized national Coal Research Center is so badly needed that efforts of the coal industry, allied industries, and Federal and state support are bound to be accorded to the plan to establish a National Bituminous Coal Research laboratory in Pittsburgh.

Coal has moved up alongside of the other industrial giants of America in recent years. It needs to be kept there as industrial insurance to other industries, to the states, and to the Federal Government in this day of need of a strong overall national industrial machine.

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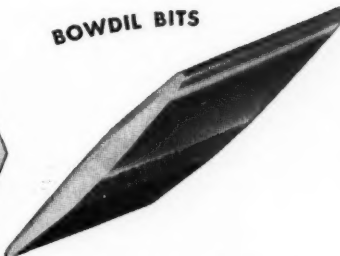
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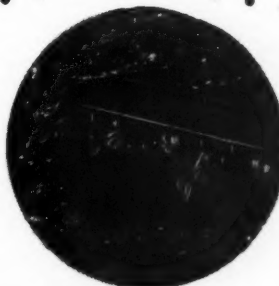
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New Castle, England — Alberta, Canada

**THE
BOWDIL
COMPANY
CANTON, OHIO**

The Copper Industry in 1957

Despite the decline in copper prices, the industry looks to the future with confidence

By J. B. PULLEN

Assistant General Manager
Phelps Dodge Corp.

J. B. Pullen has an exceptionally strong background in operations with various branches of Phelps Dodge Corp. In 1938 he became superintendent of the underground mining department of the United Verde Branch and advanced to general superintendent in 1943. From this he was promoted to the positions of manager of the Copper Queen Branch, manager of the New Cornelia Branch, and, about four years ago, to his present position as assistant general manager of western operations of the Phelps Dodge Corp. Jack Pullen has become widely known for his keen analyses of the economic situation in the copper mining industry; thus it is particularly appropriate that he author this year's review of copper.

THE copper review for the year 1957 is quite a contrast to those of recent years in which the reviewers were able to report a generally



prosperous industry, news of high production rates, expansion of facilities, fair to excessive prices and high level of earnings for all producers. The reverse trend which first became evident during the last half

of 1956, continued throughout 1957. The industry is now faced with a supply of the metal which is in excess of demand. Prices have fallen to a point where it is impossible for some production units to operate at a profit. Many operations have been forced to curtail output, and a few isolated operations have found it necessary to close down entirely. All of the operating companies have suffered a drastic reduction in earnings, and a few have suffered serious losses.

The following tables covering: domestic, free foreign and total free world production; deliveries and stocks; and the monthly average E & M J domes-

tic price at the Connecticut Valley for the year 1956 and the first eleven months of 1957 indicate the gain in producers' inventory of the metal in the face of the drastic decline in its selling price.

It will be noted that the stocks of refined copper in the producers' hands on a free world-wide basis have increased from 217,315 tons in January of 1956 to 425,678 tons at the end of November of 1957; and the E & M J average price for copper delivered to the Connecticut Valley has dropped from 44.049 cents to 26.739 cents during the same period. Custom smelters were at the time of this writing quoting an even lower price of 25 cents, and copper on the London metal exchange was selling at an average of about 23 cents per pound.

\$.32 is Realistic Peril Point

Many of the American producers are seeking restoration of the original 4 cents excise tax on imports,

applicable, however, only when the domestic price is below a more realistic level of 32 cents. Proponents assert that all of the American production can be absorbed by American consumption, and security reasons demand that the United States have a strong and going copper production industry. It is impossible for the marginal producers and several of those properties developed under the Defense Production Act to continue operations at present prices. Existing legislation provides until June 30, 1958, for the imposition of a 2 cents excise tax on copper when an average monthly price is below 24 cents per pound. The base or floor price of 24 cents, at which free importing begins and which is now generally called the "peril point," was established by Congress in 1951 and was considered the bottom price at which most American producers could profitably operate.

Domestic producers without substantial foreign mines are now asking legislation that will restore this tax to at least the original rate of 4 cents per pound and to raise the peril point from the outdated 24 cents to a currently realistic 32 cents per pound. They say the increase in the rate to 4 cents per pound would partially compensate for the cost differential existing between American and foreign production. Increasing the peril point to 32 cents is to compensate for the rise of production cost since the legislation was enacted in 1951.

Opponents are saying the economy of some foreign countries is substantially dependent upon their copper industry, and the raising of the United States tariff might be accompanied by a loss of political good will abroad. On the other hand it is alleged that failure to adjust supply to demand has caused greater damage to their economy because of the price collapse.

E & M J MONTHLY AVERAGE DOMESTIC QUOTATIONS FOR COPPER DELIVERED TO THE CONNECTICUT VALLEY

	Cents per Pound	
	1957	1956
January	35.926	44.049
February	32.976	44.888
March	31.852	47.028
April	31.917	46.461
May	31.688	45.831
June	30.734	45.356
July	29.090	41.107
August	28.498	39.925
September	26.835	38.897
October	26.735	38.923
November	26.739	35.996
December		35.949

Production Cutbacks

It is apparent that the industry has taken no concerted or uniform action to correct the supply-demand situation. Each company is facing the problem alone and is taking such action as fits in with its particular operating, personnel and financial problems. The following corrective measures voluntarily taken by specific corporations have been announced in various news releases. Phelps Dodge has reduced production by about 15 percent through a reduction in working schedules. Anaconda has cut production by about 3000 tons per month by a reduction in working schedules, curtailment of daily ore production and a reduction in the working force which is said to be about 1635 men. Kennecott Copper Corp., the nation's leading copper producer, has inaugurated a cost reduction program and has recently announced a reduction in working schedules. It is reported that in their combined operations approximately 1100 jobs have been eliminated and a reduction in production of about 3800 tons per month has been effected. Other domestic producers, such as Miami, Inspiration and Calumet and Hecla have all made substantial cuts by reducing the work schedules, curtailment, or both; while San

FOREIGN COPPER PRODUCTION, DELIVERIES AND STOCKS

(Copper Institute)
(In Short Tons)

	Foreign Crude Production			Deliveries to Fabricators Outside U. S. A.	Refined Stocks
	Primary	Secondary	Total		
1956					
January	137,185	897	138,082	111,994	187,399
February	140,434	1,808	142,242	97,458	179,833
March	143,995	1,897	145,892	120,224	174,233
April	137,487	938	138,425	102,317	183,288
May	135,755	1,133	136,888	113,284	195,923
June	140,318	1,136	141,454	105,415	205,550
July	148,395	787	149,182	101,102	215,381
August	150,013	480	150,493	115,303	219,132
September	132,742	759	133,501	115,328	218,149
October	180,323	1,303	181,626	121,431	227,833
November	158,787	1,264	160,051	124,443	228,685
December	144,281	772	145,053	136,781	235,775
Year	1,729,705	12,952	1,742,657	1,366,979	233,775
1957					
January	148,097	831	148,928	143,089	226,408
February	143,171	1,636	144,807	113,231	233,638
March	148,044	1,495	149,539	149,700	229,088
April	135,999	1,209	137,208	136,578	223,831
May	153,230	838	154,068	136,043	231,396
June	156,356	879	157,235	116,059	234,745
July	138,183	1,017	139,200	116,231	238,908
August	137,211	719	137,930	133,778	231,881
September	147,711	837	148,548	132,113	242,116
October	161,787	897	162,684	133,087	261,015
November	164,422	827	165,249	146,880	264,126
Eleven Months	1,632,191	10,585	1,642,776	1,442,890	264,126

DOMESTIC COPPER PRODUCTION, DELIVERIES AND STOCKS

(Copper Institute)
(In Short Tons)

1956	Domestic Crude Production			Deliveries	Refined Stocks*
	Primary	Secondary	Total		
January	98,364	10,353	108,717	131,453	50,018
February	91,174	11,897	103,071	140,288	47,053
March	102,459	12,598	115,055	140,288	53,263
April	98,978	12,780	111,758	144,088	56,731
May	101,422	17,475	118,897	144,761	56,208
June	98,496	12,471	110,967	133,532	60,671
July	84,787	10,387	95,174	104,580	87,944
August	81,282	9,545	90,827	116,133	98,450
September	88,959	7,367	96,326	108,402	93,202
October	95,109	12,821	107,930	118,479	106,120
November	90,573	8,940	99,513	118,192	116,516
December	92,231	12,352	104,583	104,025	120,648
Year	1,133,134	139,584	1,272,718	1,506,196	120,648
1957					
January	94,873	14,683	109,556	125,088	118,564
February	92,508	8,941	101,449	104,585	136,302
March	98,383	10,355	108,738	115,821	140,191
April	98,910	11,180	110,070	122,071	139,842
May	96,334	9,618	105,952	125,982	155,365
June	95,959	8,792	104,751	110,209	185,149
July	88,141	6,388	94,529	90,025	191,515
August	89,680	9,246	98,926	112,702	199,931
September	87,270	8,925	96,195	111,331	176,813
October	85,978	9,029	95,007	126,313	166,976
November	89,253	8,011	97,264	118,913	161,552
Eleven Months	1,020,303	103,146	1,123,449	1,280,220	161,552

* - Copper stocks (including in process, in finished goods, etc.) of United States fabricators amounted to:

End of Period	Tons
December 1956	384,361
December 1957	433,982
October 1957	420,130

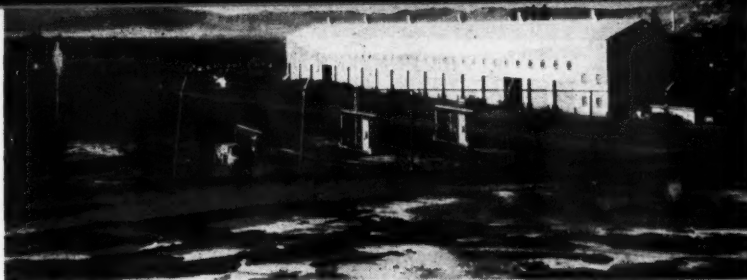
WORLD COPPER PRODUCTION, DELIVERIES AND STOCKS

(Copper Institute)
(In Short Tons)

	World Crude Production				Refined Stocks*
	Primary	Secondary	Total	Deliveries	
1956					
January	235,529	11,250	246,779	243,447	217,315
February	231,908	13,505	245,413	237,724	229,686
March	246,454	14,293	260,747	260,510	227,496
April	235,965	14,716	250,681	245,408	239,869
May	237,177	18,908	256,085	258,045	262,130
June	239,814	13,607	253,421	238,947	268,221
July	233,182	11,174	244,356	205,682	303,225
August	241,295	10,005	251,300	231,334	315,578
September	221,401	9,128	230,529	224,730	309,351
October	255,442	13,924	269,366	239,910	323,952
November	249,380	10,204	259,584	243,535	345,181
December	235,512	13,124	248,636	243,806	354,420
Year	2,852,639	152,536	3,015,375	2,873,173	354,420
1957					
January	240,970	15,514	256,484	266,177	344,973
February	235,979	10,577	246,556	217,796	370,128
March	244,407	11,850	256,257	265,321	369,256
April	234,909	12,389	247,298	258,850	363,683
May	249,594	10,456	260,050	263,025	376,701
June	232,249	9,671	241,920	228,786	400,394
July	224,324	7,403	231,727	209,256	430,423
August	226,891	9,085	235,976	237,480	434,912
September	234,981	7,583	242,564	223,444	418,939
October	254,945	8,726	263,671	258,400	427,981
November	253,675	8,638	262,313	268,593	425,978
Eleven Months	2,652,494	113,731	2,766,225	2,702,810	425,978

* - Copper stocks (including in process, in finished goods, etc.) of United States fabricators amounted to:

End of Period	Tons
December 1956	384,361
December 1957	433,982
October 1957	420,130



A fully equipped garage services all mobile equipment used at Anaconda's Berkeley

Manuel, White Pine, Pima and American Smelting & Refining's Silver Bell are maintaining capacity rates. The African mines controlled by the Rhodesian Selection Trust and the Belgian Congo producer, Katanga, have announced that their output has been reduced 10 percent. As of this writing other large African operations, as well as the large operations in Chile, have not reported reduction of their production. In Canada some of the high cost producers have shut down; while the large producers and newly-developed mines are continuing maximum production rates. In all, the total reduction to date will total in excess of 140,000 tons of copper per year with a reduction in employment of about 4000 men.

Capital Improvements and New Operating Methods

The industry continued to embark upon new programs for improvements and additions to production facilities. Among the most ambitious of these was that announced by the Kennecott Copper Corp. which included at the Utah Division an 18,000-ft tunnel from the mouth of Bingham Canyon to the bottom of the open pit mine at a cost of \$12,000,000 and an expansion to the central power plant at a cost of \$18,000,000; an expenditure of \$6,000,000 for an increase in the capacity of the power plant and new equipment at the Chino Mines Division; a \$40,000,000 expenditure at the Ray Mines Division for a new smelter, an increase of 50 percent in the mill, new crushing plant and a new leach-precipitation-float plant; the company also announced that it will build a new copper refinery near Baltimore, Maryland, that will have a capacity of 7000 tons of electrolytic copper per month at a cost for construction of \$20,000,000.

In the Phelps Dodge operations in Arizona the replacement of churn drills for blast hole drilling with large diameter rotary drills is continuing where practical, and in one pit where extremely hard ground is encountered the hammer type, down-the-hole drill is being used with a considerable degree of success. This company has also made some replacements of five-yard shovels with eight-yard shovels which promise to increase loading efficiencies. In their southwestern pits

a study is being made of the use of ammonium nitrate explosives as a substitute for the gelatins and dynamites. Also, mobile drill units with self-contained compressors, water reservoirs mounted on either rubber tired or tractor units with a projecting boom, operators chair and a mounted air drill are being successfully used in secondary drilling and blasting operations.

Noranda Mines, Ltd. of Canada have just completed a \$5,000,000 improvement program which included a 28 percent increase in smelting capacity. The company is now treating ore from 24 separate shippers.

The Anaconda Company has reported that the mining operations at the Berkeley Pit in Butte, Mont., which had previously been conducted by a contractor, were taken over by the company in July. Construction

of plant facilities for the Berkeley Pit made satisfactory progress during the year and will be available for ore production after January 1, 1958. The facilities include a 60 x 84-in. jaw crusher in the pit area and a 48-in. belt conveyor which will transport the ore through an underground inclined tunnel from a point 100 ft below the crushing plant to the surface ore bins or stock pile. In addition, a fully equipped garage was also built to service all mobile equipment used in the pit. The Berkeley Pit ore will be hauled by railroad to Anaconda, Mont., where it will be treated in the company's concentrating and smelting plants. The company also held dedication services for the newly-developed African Mine near Santiago, Chile, on October 24. This mine will have a capacity of 500 tons of refined copper per month.

The Consolidated Coppermines Corporation has reported that they have adopted the use of prilled ammonium nitrate mixed with fuel oil as a blasting agent. This company is now installing a 1000 ton per hour Rockover Skip Hoist for the removal of ore and waste from its pit at Kimberly. This installation should be completed by the middle of 1958 and it is estimated it will effect a substantial reduction in operating cost.



This down-the-hole drill, with mast that can be inclined 20° from vertical, is shown drilling seven-in. holes in Fan-glomerate formation

Inspiration Consolidated Copper Co. announced the completion of its dual process program and reported that metallurgical results to date have exceeded the original expectations. The company also reported that development work at its Christmas Mine has been resumed after the completion of a new head-frame and hoist installation. Final decision as to flowsheet and design of the new treatment plant will be made on the basis of extensive metallurgical testwork. Operation of the small existing concentrator is scheduled to start at an early date as a part of this program. It was also reported that the preparatory work for the sinking of the new development shaft is about complete.

It is reported that Bagdad Copper Corp. is presently stripping to uncover ore for additional production. Plans are under way to increase the mill capacity from 4000 tons per day to 10,000 tons per day. The company has also achieved satisfactory results with a pilot plant for producing electrolytic copper at the rate of 3000

lb per day.

Magma Copper Co. reports that the sinking of its five compartment No. 6 shaft from the 2550 level to the 3800 level was completed during the year, also that production at San Manuel reached its rated capacity of 30,000 tons of ore per day shortly after the middle of the year.

Early in 1957 the Duval Sulphur and Potash Co. completed the exploration of its Esperanza property in the Twin Buttes area southwest of Tucson, Ariz. Stripping operations and mill construction has been started for the development of the property to produce 10,000 tons of ore per day. The property is scheduled to start operating in the early part of 1959.

At Silver Bell Unit of the American Smelting & Refining Co., the company took over the mining operations which had heretofore been conducted under contract. This action necessitated heavy expenditures to fully equip the mine. Intermediate ore storage facilities were also enlarged

during the year permitting more flexible mine and concentrate operations.

Aggressive exploration campaigns were carried on in most of the promising areas of the world. The greatest activity reported was in the Ungava Nickel-Copper belt area in Northern Quebec. Other areas attracting attention included the Northwest Territories, British Columbia, Minnesota, Michigan, Southern Arizona, California, the Bingham district of Utah and several locations in Chile.

While the current situation is discouraging and many marginal producers are in serious trouble, the industry looks to the future with hope and confidence. The proof of this attitude is shown by the continuation of such ambitious programs as the development of the Toquepala project in Peru by the Southern Peru Copper Corp., the El Salvador property in Chile by Anaconda and the announcement by the Rhodesian Selection Trust of increasing the capacity of the Mufulira mines by 55 percent over the next five years.



This aerial view of Phelps Dodge's New Cornelia mine and plant and the town of Ajo reveals a remarkably compact grouping of operations from rock breaking to metal production

MINING GEOLOGY IN 1957

Salient characteristics—geophysical and geological methods widely employed, a number of important ore bodies discovered or extended, and encouraging results obtained from basic research in the processes of ore formation

By DR. PHILIP J. SHENON

Shenon & Full
Consulting Geologists
Salt Lake City, Utah

IN 1957 the mining industry passed through its worst post war period. During the year thousands of miners and technical men have been thrown out of work by curtailments and shut down mines. A year ago there were not enough geologists and mining engineers to fulfill requirements. Today many are looking for jobs or are employed in non-technical work. Exploration has slowed appreciably and research and development have been curtailed. Why the drastic change and what does the future hold for the mining geologist?

The reasons are basic. A year ago copper sold for 36 cents a pound, down ten cents from a few months previous. Today copper is quoted at 27 cents, producer price; 25 cents, custom smelter price, and 22½ cents, foreign production delivered at New York. A year ago lead sold for 16 cents. It is now 12.8 cents a pound, East St. Louis. Zinc was 13½ cents a pound; today it is ten cents. A year ago tungsten prices were \$28 and \$28.50 per unit, duty extra. Today they are \$12.75 and \$13.25. Nickel is the outstanding exception. A year ago it was quoted at 64½ cents per pound; today the price is 74 cents. Production costs have not gone down with the fall in metal prices and in some camps they are expected to go higher.

At first glance the drastic drop in metal prices may seem paradoxical for a country that does not produce enough metals to supply its consumption needs. The answer, however, is obvious. Foreign producers are shipping us more than enough metals to supply our deficiencies, and at costs considerably below the cost of production in this country; and mines that lose money are forced to close down. The mining geologist is interested in the solution to the problem because active exploration work, and

even his job, depend upon a prosperous mining industry. Also, what encouragement does a young man thinking of a mining or geology course get from an industry that may at any time lay off its technically trained men, and particularly at this time when we are informed that we must train thousands of scientists and engineers to meet Russian competition.

Much thinking has gone into the problem, some of a long-range nature but mostly of a stop-gap variety. In June the administration presented its "Long Range Minerals Program" to the Senate Committee on Interior Affairs. The program generally was a disappointment to the mining industry which had hoped for recommendations that would have more immediate effects than the proposed program offered. Industry found the proposals for increased topographic and geologic mapping, and basic research commendable. To a degree the industry also supported the proposal for expanded exploration assistance, but some took occasion to point out that the finding and development of new ore bodies is of little value if the potential market for the product is

pre-empted by low-cost foreign production.

Various means have been proposed to improve the state of our mining industry, by such expedients as more stock piling, a continued commodity barter program, a premium price plan, quotas and protective tariffs. A protective tariff is most generally favored by the mining companies but those with large foreign interests do not lend their support. Congress adjourned in September after the House Ways and Means Committee refused to impose a sliding scale import tax on lead and zinc. Next, an appeal was made to the Tariff Commission for relief under the escape clause. Hearings were held in November and the decision of the Commission is awaited with great interest.

Exploration—A Change in Approach

Exploration slowed appreciably in 1957, particularly in this country, and several companies actually disbanded their exploration departments. This was due in part to decreased incomes, but also to a change in approach that makes competitive exploration very expensive. A few years ago much dependence was placed on the individual prospector. Today very large areas, extending over thousands of square miles, are being intensively explored by both geophysical and geological methods. The smaller companies now find it difficult to compete on this scale and some of the projects are so expensive that even the larger companies have had to pool their interests.

In Canada, particularly, the geophysical approach is stressed in exploration. Canada spent 40 percent of the world's total expenditures for geophysics in 1956 and may exceed this figure in 1957. Canada also has for many years done extensive photogrammetric mapping and is now considering the world's largest and probably most difficult mapping job. The Northern Miner stated that the Canadian Government plans to spend \$6 million to photograph the Canadian Arctic for detailed mapping purposes. The photography will cover 500,000 square miles and will require the services of a dozen planes for six years.

In the United States private companies and Federal and state surveys have been doing considerable geophysical work, along with geological mapping, in order to select areas for exploratory drilling.

New Discoveries and Developments

A number of important ore bodies were discovered or extended in 1957.

Exploration for uranium continued active but less so than in 1956. It is interesting to note that a few short years ago the "have nots" were telling us that we could expect very little uranium in this country. An incentive

Philip J. Shenon of Shenon & Full, consulting geologists in Salt Lake City,



is a graduate of the University of California School of Mines and the University of Minnesota. Dr. Shenon began his career with the U. S. Geological Survey and later was exploration geologist for the International Nickel Company of Canada. Between 1949 and 1952 he headed the Mining Department of the University of Utah. Since 1952, with R. P. Full, he has served numerous mining companies as consulting geologist in this country and abroad.

program was nevertheless set up by the Atomic Energy Commission, which apparently did not take the views of the "have nots" too seriously, and today our problem is not one of under-supply but of over-supply. On October 28 Jesse Johnson of the AEC took the industry by surprise when he stated: "We have arrived at the point where it no longer is in the interest of the Government to expand production of uranium concentrates. . . . Under these circumstances the Commission at this time is faced with limited commitments for additional uranium production." Johnson also stated that the Commission expects to be buying 15,000 tons of uranium concentrates by 1959. In the first half of 1957, 4200 tons of concentrates were produced by 12 mills. The Engineering and Mining Journal reports that some 23 approved mills, with a daily ore capacity of 20,310 tons, are scheduled for the period ending in 1959. Mining World reported ore production for the first half of this year at about 1,620,000 tons and the U. S. reserve on June 1, 1957 as 67,240,000 tons. At the projected production rate for 1959 we will have only ten years' reserve, so there is still a job to be done by the mining geologists in this country.

The future of our uranium industry is tied in very closely with Canada and South Africa, particularly if a free market develops after March 1962. The Northern Miner estimates that the Blind River district alone may have 500,000,000 tons of 0.1 percent ore, equal to 500,000 tons of U_3O_8 . Recent estimates of South African

Self-potential crew
in central Idaho



reserves place them at 1.1 billion tons containing around 370,000 tons of uranium oxide. This reserve, in addition to coming from tails of gold ores currently being mined, is also derived from gold slimes accumulated in surface dumps during earlier years. The average uranium content of the gold ore residues is only 0.47 lb per ton, but it must be remembered that this is by-product material and that American and British sources have provided the capital expenditures of about \$182,000,000 for plant construction. Between 1963 and 1967 these loans will have been redeemed. In a free market the better grade of the U.S. ores (0.26 percent U_3O_8) would have to offset the lower costs of the Canadian and South African deposits.

Several important copper deposits were found in 1957 and most of the large companies conducted an intensive search by air and by land for

disseminated deposits, both in this country and abroad.

Inspiration Consolidated Copper Co. announced that 16,000,000 tons of ore containing 1.8 percent copper had been developed at Christmas, Ariz. Duval Sulphur and Potash Co. is considering a 10,000 tpd milling plant for its copper-molybdenum deposit in the Pima district. American Smelting and Refining Co. is reported to have discovered important bodies of copper ore in the same district. Bagdad Copper will enlarge its plant to 10,000 tpd. Lewisohn Copper Corp. has reported the discovery of important copper ore bodies at the Peach property in Arizona's Helvetia district.

In the Highland Valley area of British Columbia, Phelps - Dodge, American Smelting and Refining Co. and Kennecott Copper Corp. have taken over large blocks of ground for exploration purposes and early reports indicate that very large tonnages of disseminated ore have been found by drilling. One of the unusual features, in contrast with American "porphyry copper deposits," is the almost total lack of pyrite and molybdenite. The ore minerals in Highland Valley are mainly malachite, chalcocite and bornite.

Exploration for lead and zinc deposits approached an all time low, but in spite of it several important discoveries were made. A zinc-copper discovery, reported as the "discovery of the year," was found by the Matagami Syndicate in northwestern Quebec. Also in Canada very important zinc-copper discoveries are reported in the Snow Lake district of northwestern Manitoba.

Important iron ore developments were reported in the United States, Alaska, North Africa, Union of South Africa, South America and Canada. In the United States the St. Joseph Lead Co. has announced the discovery of three centers of iron ore deposition, about 40 miles northwest of Bonne Terre, Mo. The discovery was made as a result of an airborne magnetometer survey in 1951, and was followed by exploration work. One deposit, known as Pea Ridge, has been sufficiently



Diamond drilling in Cuba—Freeport Sulphur Co. has arranged for loans amounting to over \$100 million to cover a major share of funds needed to exploit the nickel and cobalt ores of Moa Bay

drilled to indicate a very large tonnage of commercial-grade iron ore at depths of between 1400 and 3000 ft. The two other deposits have been less extensively drilled but show encouraging results.

It is interesting to note that Anaconda Copper Co. has taken an option on an iron property in northern Ontario. The property is reported to contain ore that runs from 64 to 68 percent iron. Anaconda will pay \$10 million over an extended period for the property.

In Alaska, attention continued to focus on magnetic deposits. U. S. Steel tested the magnetite-bearing alluvial fan at Klukwan and continued exploratory drilling at Union Bay. In Canada, U. S. Steel's Quebec Cartier Mining Co. announced its decision to bring in its big low-grade magnetite deposit in the Mount Wright area. This will require an expenditure of \$200,000,000. It is also reported that Cyrus Eaton interests will go ahead with the development of their iron ore project at Ungava, also a \$200,000,000 project.

Probably the most sensational developments of the year were in northern Manitoba. International Nickel Company of Canada announced early in 1957 that it would spend \$175,000,000 for plant and mine development of its recently found nickel deposits in the Mystery-Moak Lakes areas. Three deposits have been found in an area 80 miles long by up to 10 miles wide. A large power plant, 30 miles of railroad, a concentrator, smelter, refinery, and a townsite to house 8000 people will be built. The operation will add about 130 million lb to INCO's annual output. Production should start in 1960. Important discoveries and initial exploration are also reported in the Wakeham-Cape Smith nickel belt of Ungava.

Mining Engineering announced that Freeport Sulphur Co. has arranged for loans amounting to over \$100 million to cover a major share of funds needed to exploit the nickel and cobalt ores of Moa Bay, Cuba. A refinery will be constructed at New Orleans. Moa Bay is expected to produce 50 million lb of nickel and 4.4 million lb of cobalt annually and is slated to be in operation in mid-1959.

Titanium, the magic metal, was not neglected in 1957. A major discovery of ilmenite-bearing sand appears to have been made in New Jersey, within 50 miles of established pigment plants. Markewicz and Parrilo (G.S.A. Abstracts, 1957) state that four potential ore bodies, of 1000 or more acres each, have a 1 percent TiO content to a depth of at least 20 ft. In contrast with the Florida sands, the percentage of associated heavy minerals is very low.

Several important non-metallic developments were announced in 1957. National Potash Co., a joint venture

of Freeport Sulphur and Pittsburg Consolidated Coal Co., completed sinking two shafts and construction of a 21-mile pipeline in Lea County, N. M., about ten miles east of the producing potash area in Eddy County. The \$19 million project will have an annual capacity of 40,000 tons of muriate, containing 60 percent K₂O. Another joint venture of National Farmers, Kerr-McGee Oil Industries and Phillips Petroleum, known as Farm Chemical Co., announced early in the year that they had let bids for a shaft 1700 ft deep on their property east of Carlsbad. The company expects to be producing potash in 1958.

In 1957 six American companies and one Canadian company had obtained permits from the Saskatchewan government to explore large acreages for potash. Potash Company of America secured its permit in 1952 and after a great deal of drilling started a shaft. This shaft, located near Saskatoon, had reached a depth of 2000 ft in 1957. By 1957 International Minerals and Chemical Corp. had also started a shaft, near Esterhazy. The Northern Miner stated as its opinion that International Minerals had located a potash bed 12 ft thick with an average grade of 30 to 35 percent K₂O and ore reserves for over 80 years of operation. Informed sources state that Saskatchewan has the world's largest and highest grade known potash deposits. However, they occur at depths of over 3000 feet. In comparison, the New Mexico deposits are reported to average about 21 percent K₂O but the developed deposits are found at depths of from 800 to about 1700 ft.

The Northern Miner stated that available information indicated that the cost of a shaft in the Saskatchewan area, where the shaft must be concreted through pre-frozen ground, will be about \$7 million and that the overall cost of bringing in a potash mine with an annual capacity of 650,000 tons will range from \$27 million to \$30 million.

During the current year phosphate deposits of great geological interest were actively explored in Beaufort County, N. C., by Bear Creek Mining Co., International Minerals and Chemical Co., and General Crude Oil Co., a subsidiary of Sun Oil Co. The phosphate occurs in beds of friable sands, of variable thickness, at depths that range from 40 ft to over 150 ft below the surface. The surface is generally 5 to 50 ft above tide water level and the mining of the deposits presents a major technical problem.

New interest has also developed in our western clays as a source of aluminum. In October, the Anaconda Co. announced that it would complete a \$1 million pilot plant for recovery of alumina from Idaho clays. Results of the tests will determine whether or not Anaconda will go ahead with construction of a \$45 million plant for

a full-scale alumina-from-clay recovery plant in the Moscow area. J. R. Simplot has also announced that his firm will go ahead with plans for a \$1 million clay processing test plant near Bovill, Idaho. This plant would be designed primarily to up-grade clays for use in ceramics, insulators, and the manufacture of paper.

Basic Research in Ore Formation

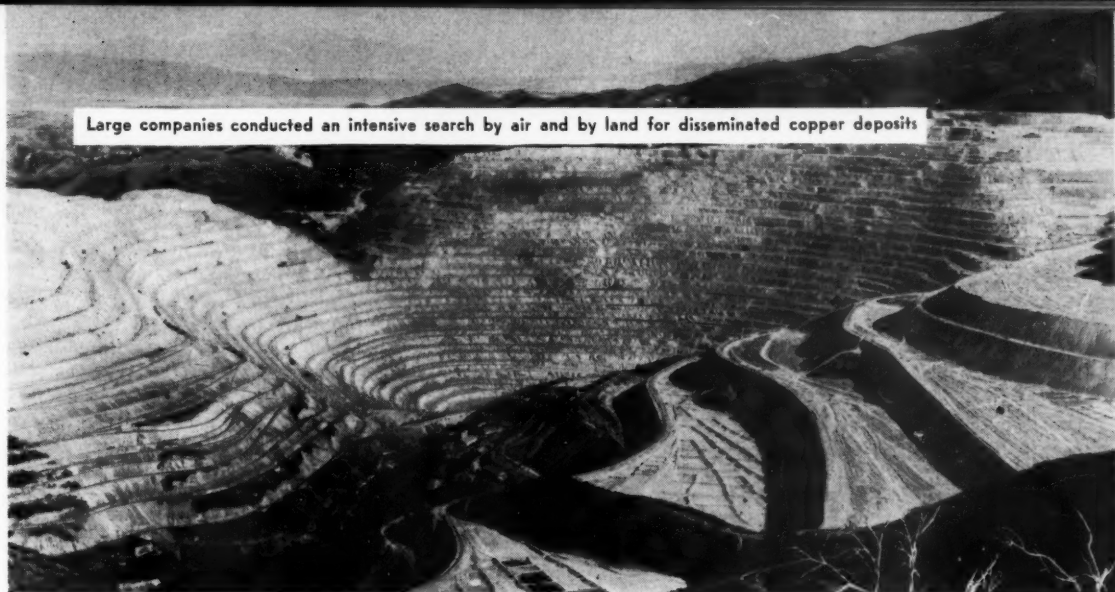
All mining geologists recognize the need for a better understanding of ore forming processes. The administration's "long-range program" stressed it and industry for a number of years has sensed the need for more research. The National Science Foundation's Committee on Minerals Research, with James Boyd as chairman, recommended an independent research institute to carry on intensive fundamental research in the earth sciences, particularly in the field of ore finding. It was hoped that supporting funds would come from industry but, with the falling metal prices, the committee has had to report that sufficient financing for the Institute is not now available from industry and that other sources would have to be sought.

Basic research in ore forming processes has been carried forward throughout the year at several universities and by government agencies, such as the U. S. Geological Survey and Geophysical Laboratory. The results are most encouraging and, as Robert M. Garrels has pointed out, 1957 may be marked as a turning point in ore research. Several major laboratories have turned their attention to sulphide systems at high temperatures and pressures; major steps forward have been made in the understanding of wall-rock alteration and the significance of paragenetic sequences in ores; thermometric technique seems on the verge of widespread quantitative application; and new insight has been obtained on limitations of the characteristics of the ore fluids. Also, absolute age methods have been cross-checked and several techniques are now available for determining ages of rock-forming minerals, and the beginnings have been made on the use of isotopes as a chemical tool to unravel ore genesis.

Work on sulfides is being carried out in several places. At the Geophysical Laboratory, Kullerud is continuing his studies of the Fe-Zn-S system and it should not be long before the interrelations of pyrrhotite, pyrite, and sphalerite compositions can be used as a satisfactory geothermometer. Accurate temperature measurements will in turn provide data on temperature gradients during ore deposition, which can be interpreted in terms of rates of ore formation.

Also, at the Geophysical Laboratory, work is being done on the influence of composition and oxygen

Large companies conducted an intensive search by air and by land for disseminated copper deposits



pressure on the stability of iron silicates and oxides.

At the Pennsylvania State University studies are being made of diffusion rates of solutes in dense gas phases containing water and other volatiles. This is a transport mechanism that may be extremely important in ore genesis.

From the University of California, Meyer and Hemley reported to the Sixth National Clay Conference the results of studies of the stability of feldspar, mica, and kaolinite, as well as other minerals, in aqueous solution in the range 250-500° C and 15,000 psi. They established the ratios of KCl to HCl at which alteration of one species to another occurs.

Workers at numerous laboratories have shown that it is possible to use micas for accurate age work. At M.I.T., Cormier determined ages of sedimentary rocks by Sr/Rb ratios in glauconite. Jensen, at Yale, has studied sulfur isotope ratios in co-existing sulfide minerals, and has made the first attempts to use such ratios in interpreting paragenetic relations. Work of this type, combined with our growing knowledge of the variations of isotopic composition of minerals within and between ore deposits, is potentially as useful a tool as gross chemical composition. Engel and others have determined important variations of oxygen isotope ratios in ore deposits. In general, the extensive use of isotopes in ore geology is just beginning, but the beginnings appear highly promising.

Barton, at the U. S. Geological Survey, has shown a method, based on ore and gangue mineral associations, of limiting the compositional range of the ore-forming fluid. He is handicapped at present by the small amount of thermochemical data available for ore-forming temperatures and pressures, but such data are accumulating rapidly, and Barton's

methods will be applicable and highly useful.

McKinstry and Kennedy, at Harvard and U.C.L.A., have inter-related mineral paragenesis with equilibrium phase relations in sulfide systems, and have shown that ore sequences follow definite equilibrium compositional paths at various mining camps.

Krauskopf, at Stanford, has contributed an important paper on the separation of iron and manganese in sedimentary processes. This work is characteristic of the rapid developments that are taking place in our understanding of low temperature processes.

Another very interesting line of research has been carried on by Charles Milton of the U. S. Geological Survey. He has found an unusual suite of minerals in the Eocene (Green River) lake deposits of Wyoming. Some of the minerals are new, but others had been found previously only in pegmatites or in hydrothermal deposits. Milton has described these minerals as having grown in the lake beds (authigenic) under a low temperature quasi-magmatic environment. It will be recalled that the Green River formation contains the world's largest known accumulation of oil shale, numerous producing oil and gas fields, large deposits of gilsonite, and other solid hydrocarbons, and extensive deposits of almost pure trona (soda ash).

Geological Publications

Many publications describing mining districts and ore processes were published in 1957. In this country the Geological Survey, as usual, issued a number of high quality reports, among them Professional Paper 285 on the West Shasta Copper-Zinc District, and 289 on the Garfield Quadrangle, Colorado. Two fine papers on foreign areas were also

issued by the Survey; Professional Paper 290 on the Congonhas District, Brazil, and Bulletin 1040 on the Cordillera Negra District in Peru.

A number of very fine papers were published in *Economic Geology*. Space does not permit discussion of all, but a paper by Sullivan (Vol. 52, No. 1) and by Knight (Vol. 52, No. 7) and another paper by Sullivan in the *Canadian Mining and Metallurgical Bulletin* (October 1957) should receive comment because the concepts of ore formation postulated by both writers are at such wide variance with the hydrothermal concept generally accepted in this country. Knight says, "the popular epigenetic theory, which postulates that ore fluids derive from a magma—are of no practical use as an approach to ore finding." The source bed concept, he postulates, suggests "that all sulphide orebodies of the majority of fields are derived from sulphides that were deposited syngenetically at one particular horizon of the sedimentary basin constituting the field, and that the sulphides subsequently migrated in varying degree under the influence of rise in temperature of the rock environment." Sullivan says, in the *Canadian Mining and Metallurgical Bulletin*, "that granite is not a source of ore, but a result of heat. A classification of ore with respect to source rocks is of greater prospecting value than ore classifications based on magmatic differentiation and hydrothermal theories."

As a closing note, the analysis and long-range predictions of Alvin W. Knoerr, editor of *Engineering and Mining Journal*, should be quoted: "Metal mining men can anticipate a tremendous upsurge in demand for their products during the next decade—a demand which for some metals may reach 'hang-on-to-your-hat' proportions."

Mechanical Coal Mining

Continued advances in mechanical mining reflect determination to improve the competitive position of coal in fuel markets

By RALPH E. KIRK

Kirk & Cowin, Birmingham, Ala.

AT the end of 1957, the bituminous coal industry faced some unpleasant facts directly related to current marketing conditions and the resultant effects on production problems and profit positions. The optimistic forecasts made at the beginning of and at various intervals during the year made dismal reading at year's end. Moreover, more recent market appraisals by realistic investigators offer little comfort in short term prospects for coal consumption.

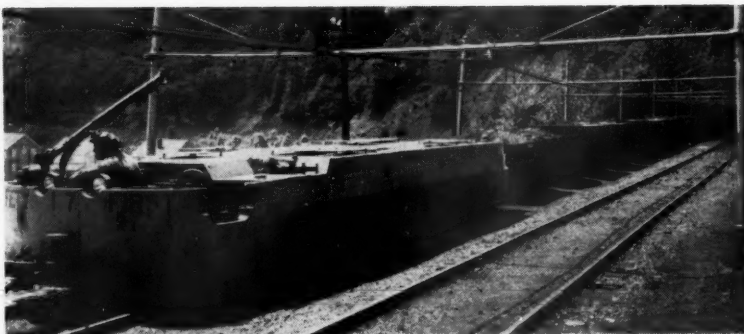
Production Off 11,000,000 Tons

The bloom faded rapidly from the optimism concerning prospective increased demand that prevailed at the end of 1956. By the end of the first quarter of 1957 earlier estimates of the increase in production for the year had been halved. By the end of the second quarter it was evident that the increase would actually be nil. By the end of the third quarter all but the incorrigible optimists were reconciled to the idea that production would be "somewhat less" in 1957 as compared to 1956. By year's end it appeared that the predicted "somewhat less" production would be on the order of 490,000,000 tons, off 11,000,000 tons from 1956.

Two favorable circumstances in 1957 made the comparison with 1956 production look better than it would have been otherwise: no industry-wide strike in steel 1957, and unusual stockpiling of coal in Europe as an aftermath of the Suez crisis.

Unless demand in 1958 materializes from sources not now evident, a further loss of market is indicated. It is entirely possible that production in 1958 will be only moderately more than the 1955 production of 465,000,000 tons.

Although there appeared little likelihood of imminent loss of a substantial segment of coal's present markets to atomic power, the long term possi-



Approximately 490 million tons of bituminous coal were produced in 1957

bility of drastic changes in conditions of coal's markets as an aftermath of a major scientific break through in this field cannot be lightly dismissed.

Further considerations on the pessimistic side include lack of any evidence of diminishing pressure for increased remuneration for labor; the steadily rising costs of rail transportation; technological advances in the steel industry in the utilization of coal; the published figures of proved reserves of crude oil and of natural gas liquids showing that each is the highest in history; and the upward trend in production of petrochemicals.

Mechanization Must Be Emphasized

These factors suggest strongly that emphasis on mechanization of underground coal mines must be continually studied, stressed, and advanced if presently indicated market trends are to be successfully counteracted. Ipso facto, effective measures designed to reduce costs of production to the degree necessary to expand coal's current markets substantially and permanently depend for their success largely on productivity based on efficient mechanization.

On the optimistic side, it is very encouraging to note the diligent efforts of equipment manufacturers to



Operating with a single prime mover, a-c, d-c or diesel, this shuttle car has a torque converter with a three-speed, forward and reverse, constant mesh transmission that contributes materially to efficient operation on grades

After graduation from Pennsylvania State University, Ralph E. Kirk went to work for a construction company.



Shortly thereafter he joined Bessemer Coke Co. as assistant to the chief engineer. Since then he has had broad experience in operating and administrative capacities in the bituminous coal and anthracite mining industry. In 1943 he became manager of raw materials for the

Tennessee Coal & Iron Division of U. S. Steel Corp. with responsibility for the production of iron ore, coal, limestone and dolomite for use in TCI's manufacturing plants. He is now a member of the firm, Kirk and Cowin, consulting registered professional engineers in the minerals industries.

improve or modify basic designs as necessity for such changes is clearly indicated.

Also, great strides have been made within the coal mining industry by engineering personnel, in accurate appraisal of physical conditions found in production areas, the design and characteristics of available equipment and progressive suggestions for improvement, and modification of projections and plans in order to attain the maximum degree of benefit from efficient utilization of equipment.

Operating personnel in general has undergone great changes in attitudes and skills with respect to mechanical equipment in the last decade. Especially notable is the increase in emphasis on effective maintenance programs and recognition of the benefits to be derived from properly directed industrial engineering studies. It is not unusual for supervisors to speak confidently of attaining more than 20 tons per manday, overall, whereas a decade ago there was considerable skepticism voiced about reaching production rates of ten tons per manday, for all employees in both cases.

An accurate reflection of the degree of interest in continuing improvement of equipment can be obtained by a resume of information released recently by manufacturing interests.

Recent Developments in Equipment Design

The manufacturer who has attained the greatest total sales volume in continuous mining machines brought out three new models during 1957, two of the ripper type and one of the boring type. Gathering arm cleanups, replacing the scrolls previously employed, and availability of integrally-mounted roof drills are featured on the ripper type machines. The boring type, weighing 40 tons and the heaviest such machine currently available, is equipped with broad self-cleaning crawler treads. The resulting claimed "floatation abil-



Equipment manufacturers continued efforts to improve or modify basic designs. One manufacturer of continuous mining machines brought out three new models during 1957. One of these, a boring type machine, weighed 40 tons and was adaptable for use in seams over six ft thick

ity" is only 23 psi on the treads. This large and powerful machine, 260 hp, is obviously adaptable for use in seams not less than six ft thick, whereas the low type ripper is but 32 in. in height.

Two additions to the line of loading machines include a medium capacity model 26½ in. in height, and a high capacity machine 43 in. high. These are welcome additions to the line for coal producers whose operations are in the thinner seams.

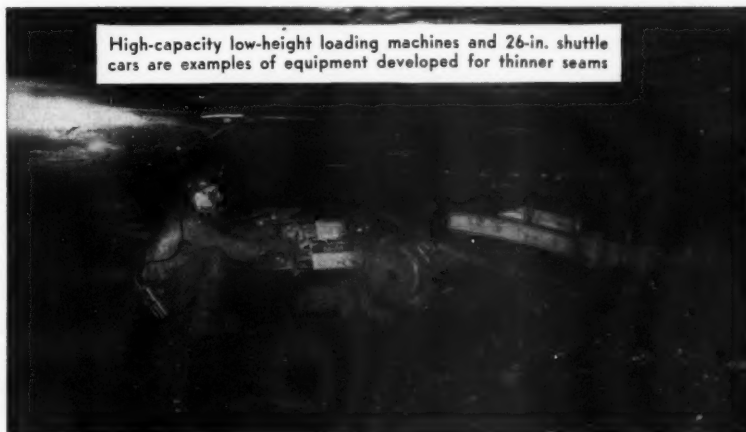
A new type shuttle car has a horizontally articulated construction in the middle of the car which allows the use of a six-wheel design. The two center wheels drive the car. The two wheels on each end of the car are used for steering. The steering wheels are mounted on compensating devices which replace the conventional pivot axles, permitting two wheels at one end to assume different horizons with respect to each other while the car bed at that end remains parallel with the center pivot of the car. The manufacturer's stated objective is "a very low height shuttle car that can carry a large pay load, conform to the mine floor, yet maneuver easily in tight places."

Contemporaneously with the development of the shuttle car just de-

scribed are three new models of more conventional design mechanically. One of these is a six-ton car of unusually rugged design for use in seams of low or medium height. Another is a "giant" handling a 13-ton pay load in thick seams. The third, of ten-ton capacity, is designed for use of a-c power.

This manufacturer has also made interesting changes in design of extensible and rope belt conveyors. The tail section of the extensible conveyor is now provided with an integral belt and swivel pulley to keep the tail pulley square with the moving belt regardless of tail section position. Newly designed belt turns provide for the feeding of belting into the conveyor from mobile tail pulley sections, to the extent of the needs for an entire shift, without stopping the transportation system during production.

Another manufacturer of continuous mining machines points out that the first of his machines, built in 1952, is still in operation, as are all other units of this type that have subsequently been built. More machines of this type were built and installed in 1957 than the total in the five-year period beginning with 1952 and ending in 1956. This unit has adhered closely through the years to



High-capacity low-height loading machines and 26-in. shuttle cars are examples of equipment developed for thinner seams

the original basic design, namely oscillating-milling type cutters, dual gathering arm loading device with swinging rear conveyor discharge. However, many important improvements have been made at intervals since the initial production in 1952, with the emphasis on "more power, more strength, more reliability." Claims of marked improvement of size consist with this unique type of cutter head seem to be confirmed by the limited data presently at hand.

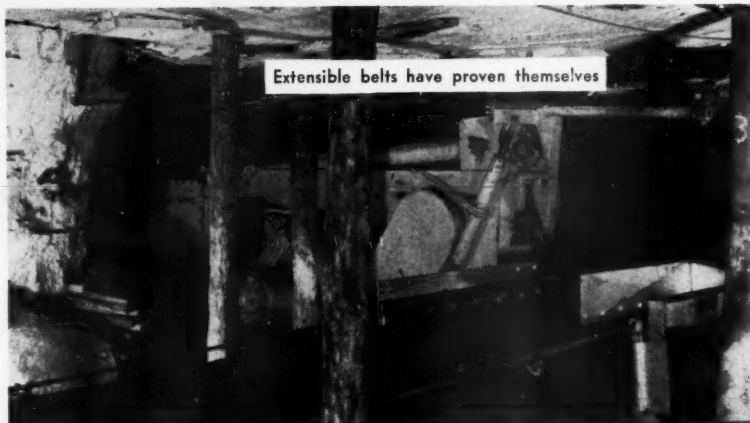
Forthcoming production of this unit will be available for 250 volt d-c, 550 volt d-c, 220 volt a-c and 440 volt a-c. Moreover, a "Low Coal" continuous machine, 26 in. in height and adaptable for use in coal seams ranging from 32 to 42 in. will be available in 1958.

A valuable piece of equipment from the standpoint of minimizing traveling time is the mine portal bus. The sale of this equipment in 1957 almost equalled in number the total number sold in all previous years since its introduction to the industry.

Another manufacturer who has entered the field of marketing continuous mining machines in recent years after a prolonged period of experimentation and development of a boring type machine is reaping the rewards for his patience and persistence. Gratifying results in both production and maintenance have been repeatedly reported. In one outstanding installation, modification of the mining system by the mining company management was apparently an important factor in the degree of success attained.

Although the initial installations of this machine and the most publicized tonnage records to date have been in a thick seam, a medium height borer with a tramping height of 40 in. and a low type model have been added to the line and similar success in operation and maintenance seems assured, by the improvements made as a result of extended experience with the larger machine, while retaining the basic design that has proved to be very satisfactory.

This manufacturer is displaying a gratifying degree of interest in de-



Extensible belts have proven themselves

veloping low type equipment for the thinner seams as promptly as such development appears warranted. The 26-in. shuttle car in use in quite a number of operations is a noteworthy example.

The manufacturer, in view of the capacity for production demonstrated by his continuous borer, realized the necessity of developing continuous transportation for the coal from the borer if the best results possible in production were to be attained. A conveyor utilizing wire rope to support the belting with mobile head and tail sections was developed. It has been an important factor in attaining the good production records reported for the borer. A notable feature is the varying height discharge, obviating the need for shooting top in order to obtain sufficient height for discharge. Two hundred ft of belting can be added in approximately ten minutes, according to information at hand.

The past year saw an established company in other fields of the industry making its bow as a manufacturer of continuous mining machines and shuttle cars. This company has undertaken the manufacture of a machine based on the well known McKinlay principle but with new and unique changes in design. The transportation mate of this machine is a shuttle car of new and unusual design.

The design of the continuous mining unit includes many unique features and an adequate description is quite beyond the scope of this article. Extensive field tests of the machine have been made, with results in both production and maintenance reported to be very satisfactory.

One of the main design features is the use of two frames. The cat frame carries the propelling mechanism on which are mounted the motors and pumps. The main frame carries the gear box, two 70-hp motors, a-c or d-c, cutting head and conveyor. Positioning of the main frame, with respect to the cat frame, is accomplished by operation of four leveling jacks, separately or in groups. This permits tilting the bottom cutter bar through a range of 15 in. below the cat treads to a similar distance above the treads. The main frame may also be inclined laterally, to the right or left, approximately 8°.

The shuttle car being marketed by the same manufacturer has been designed and developed after extensive field trials covering a period of more than four years in operations of the largest coal companies in this country. It has the exclusive feature of operating with a single prime mover, a-c, d-c or diesel. The torque converter with a specially designed three speed, forward and reverse, constant mesh transmission contributes materially to efficient operation on grades. Cars have been used satisfactorily on grades ranging from 10 to 15 percent.

Another manufacturer has succeeded in attaining a prominent position in the industry within a few years. The progressive designs of his products have kept pace with the changing trends connected with the mechanization of underground coal mines in this country.

The bridge conveyor has been so successful that there is a tendency to use the term "Piggyback" categorically, without recollection that the term is covered by copyright granted

(Continued on page 77)



Improvements on the original basic design of this continuous mining machine have emphasized power, strength and reliability



Reserves of iron ore in the Lake Superior district, even when compared to some of the astronomical estimates for other parts of the world, can truly be called enormous. Pictured is a typical operation in the Western Mesabi district

Iron Ore—Review and Outlook

Nineteen fifty-seven saw a continuation of the trend toward the development of iron ore sources to supplement our traditional Lake Superior producing areas. Work on foreign deposits, both in Canada and overseas, continued to receive vigorous support, and there were a number of developments in low-grade beneficiation, particularly with the taconites

OVERALL, the iron ore picture is one of continued vigorous expansion of new supplies; of increased emphasis on research and technology which seems to be paying off; and of growing attention to the matter of improving the grade and structure of iron ores. Together, these things suggest that we may be approaching a new era in the economics and technology of iron ore supply, with tremendous implications for everyone in the business.

Steel production for 1957 averaged 84 percent of the industry's January 1, 1957 capacity. This was the third record year, exceeded only by 1955 and 1956 . . . 112,700,000 net tons of ingots and steel for castings were produced in 1957 compared with 117,000,000 tons in 1955, the all time record year. The answer, of course, lies in the fact that capacity is at an all time high—133,000,000 net tons annually.

New High Quality Ores

As you well know it took quite a bit of iron ore to make this much

By **RUSSELL C. FISH**

Vice-President Operations,
The M. A. Hanna Company

steel. 1957's total receipts were 133,000,000 gross tons of iron ore, of which over 36,000,000 tons were Canadian and overseas imports. Imports were appreciably ahead of any previous year. This is a continuation of a trend which showed up in 1956 during the steel strike. While our own Lake Superior production dropped 10,000,000 tons in 1956 from 1955, imports jumped from 23,400,000 to 30,500,000 tons. The Lake Superior District shipped 84,600,000 tons in 1957. Obviously, the foreign ores have something—and that something is quality. From now on, it will increasingly be the case that even the best Mesabi ores will have to be treated to improve their physical structure, their size, or their chemical analysis—or all three—before they can meet the new standards of quality now being set

up. The trend to beneficiation has moved in great strides in recent years. Five years ago only 30 percent of Minnesota's ore production was in concentrates. In 1956 the total was 43.8 percent, in 1957 it may go well beyond 50 percent and many of the independent operators are treating, in one form or another, 75 percent of their production.

Actually, of course, this has been developing for some time. It started when Labrador ores began to reach the market in appreciable tonnages. It stepped up when Venezuelan ore became widely available. It became official when steel mills began to get a taste of the new taconite pellets. What has happened is that the emphasis has shifted from the cost of ore to the cost of iron in the ladle which is, after all, the figure a steel company cares most about. It became rapidly apparent that richer ores and ores with better structure resulted in a lower overall cost of operation, even if it did cost more to go get them and bring them back.

Russell C. Fish, a mining engineer graduate from the Case School of Applied Sciences, is a longtime employee of the M. A. Hanna Co. He has grown with—and within—this remarkably successful mining firm, having advanced steadily through engineering and operating positions in Hanna's Lake Superior districts. Russ became general manager with Hanna in 1946, and ten years later, in 1956, was named vice president.



Speaking generally, charging a burden of taconite pellets or rich foreign ore increases the productivity about 20 percent over what it would be with a burden of 50 percent iron Mesabi Ore. Putting it another way, one operator reports a savings of 26 cents a ton in the cost of pig iron for every percentage point reduction in the silica in the ore he charges, down to the level where the fluxing needs of the furnace are no longer met.

Inland Steel reports that a burden of 40 percent sinter—which would be the equivalent of one of the richer ores—will decrease coke consumption from 9 to 18 percent and increase production as much as 20 percent.

So, when you add together increased productivity from existing facilities, plus lower slag rates, plus lower coke rates, and frequently, plus a better quality iron, you see why it pays to spend money to find and develop foreign ores or to improve domestic ores.

And it takes money, make no mistake about it.

Investments as high as \$46 per annual ton of iron in foreign projects are not unknown, and the taconite developments in the Lake Superior region have run to \$55 per annual ton. There is one escape clause here, of course. Usually, original capacity can be doubled for far less than twice the original cost, when demand becomes great enough.

Most of the exploration during 1957 reflected this growing concern for the quality of ore as well as its quantity. The searches have been either for foreign reserves of exceptional richness or, increasingly, for low-grade deposits which can be easily beneficiated into wonderful ores running as high as 66 percent iron. As you might expect, much exploration activity was concentrated in that great arc of iron formation that extends almost continuously from the northerly tip of the west coast of Ungava Bay to the Mistassini area of Quebec.

New Iron Mining Projects

In one important development, U. S. Steel is expected to have a 5 million-ton-a-year beneficiation plant at Mont Wright, Quebec, by 1961.

Formation of a new corporation, Wabush Iron Co., Limited, by Canadian Javelin, Pickands Mather, Steel Company of Canada, and some American producers has been reported. It is exploring a 2300-sq mi concession near Wabush Lake.

Cleveland - Cliffs Iron Co. has formed a corporate partnership with M. J. O'Brien Ltd to investigate ore indications in the Lac Albanel region of Quebec.

Pickands Mather expects to be in production this year with a mine and beneficiation plant, known as the Hilton Mine, on the Ottawa River in Quebec. Production is estimated at 600,000 to 750,000 tons of pellets a year.

Also in the same area, Jones and Laughlin is considering what is thought to be a large deposit of easily beneficiated ore.

M. A. Hanna is building a beneficiation plant at Moose Mountain, Ontario, planned for an initial production of 500,000 tons of concentrates a year.

Belcher Mining is exploring Belcher Island in Hudson's Bay.

Erie's taconite project began operation in 1957, with a rated capacity of 7,500,000 tons per year.

Marquette Iron Mining Company, composed of Cleveland Cliffs, Inland, Jones and Laughlin, Wheeling Steel and International Harvester continues to work on Upper Michigan Jasper. Cliffs this year put into operation its Eagle Mills pelletizing plant.

Hanna Coal & Ore Corp. has under construction a plant to process Jasper at Groveland, on the Menominee Range of Michigan.

Six new beneficiation plants have gone into operation in Minnesota this year, bringing the total in the state up to 78.

In the Western District, Kaiser Steel has embarked on a long-range expansion program involving new furnaces and new ore to feed them and is installing a jig plant at Eagle Mountain.

The Utah Construction Company is making studies on beneficiation of lower grade ores and have in operation a pilot plant.

U. S. Steel has completed engineer-



Huge investments were required to get into production in the Labrador field, but once made available, the ore has something—and that something is quality

Overseas, a new project in Venezuela is being talked of at El Trueno, southeast of U. S. Steel's Cerro Bolivar, and other ore bodies nearer Cerro Bolivar may also be opened.

A number of companies are continuing investigations in Brazil. U. S. Steel is investigating a large body of low-grade magnetite in Alaska.

The story of better grade would not be complete if we did not recognize that 1957 has also been the year taconite production moved definitely into the big time. Reserve's E. W. Davis works at Silver Bay, rated at 3,750,000 tons, has been producing steadily at the rate of 5,000,000 tons a year. And when you consider that Reserve had to mine more than 16,000,000 tons of rock to get its pellets, you get some idea of the magnitude of taconite operations even at this early date.

ing work on a plant to treat a taconite-like formation at Lander, Wyoming. The project would involve a 90-mile railroad. The Texada Mines Limited of Vancouver are mining substantial tonnage primarily for the Japanese market.

Consideration of the constant pressure to upgrade ore before it is fed into the blast furnaces should certainly include mention of the 18 new sintering lines at the furnaces with an annual capacity of 25,000,000 tons which were under construction during 1957. This brings the total sintering capacity at the furnaces in the United States to approximately 50,000,000 tons.

Of course, there will always be a place for advantageously located ore deposits which make up in convenience for what they may lack in other virtues. After all, about 40 percent

of the delivered cost of even Lake Superior ore is in transportation and handling—and if you can cut that, you can afford to absorb other expenses.

Bethlehem Steel is nearing production on its Grace Mine at Morgantown, Pennsylvania. Production should start in 1958 at the rate of 6,000 tons of concentrate a day.

In Missouri, drillers for St. Joseph Lead hit iron ore near Bonne Terre and Bethlehem is now cooperating with them on an exploration project. This promises to be a major find. The ore body is large and of good quality. Ultimate production of 2,000,000 tons a year is thought possible.

Also in Missouri, Granite City Steel and American Zinc are in partnership on an exploration project.

Possibilities in Direct Reduction

Finally, 1957 may be remembered as the year that saw the break-through on a practical method of direct reduction. This, of course, has been the real will-o-the-wisp of the steel industry. It has broken hearts, cost fortunes, and ruined reputations. But it may be here now, and in several different forms, each with its own merits.

Republic Steel and National Lead, through their jointly owned R-N Corporation, have announced a process which employs a rotary kiln and low-grade fuel to reduce iron ore with carbon monoxide at temperatures in the neighborhood of 1900° F. A magnetic separator then concentrates the iron and rejects silicon and some other impurities. In the final step, the iron powder is made into briquets running between 85 and 95 percent iron. The R-N process is reported to work quite well with low-grade ores, which it turns partly into melting stock for steel furnaces and partly into blast furnace feed. From high-grade ores, it is reported to produce the equivalent of No. 1 heavy melting scrap.

Bethlehem and Hydrocarbon Research, Inc., have been working for more than seven years on their H-iron process which is also reported near commercial feasibility. It uses hydrogen instead of carbon monoxide, and operates under rather low temperatures—about 900° F—and high pressures—about 400 psi.

The Krupp-Renn process has achieved a relatively firm but limited foothold in those localities where this process fits the economy. Certain low-grade ores not amenable to ordinary beneficiation methods can be reduced in a rotary kiln to small metallic nodules called "Luppen". Since 1950 new Renn plants have been completed or are under construction in Spain, Germany, Greece and India.

At least four other approaches are being made to the problem. United States Steel is designing a large plant which may be located at the

Fairless Works. Arthur D. Little is developing a process using Esso Research & Engineering patents. Other interests are investigating a process developed by Julian Madaras in Texas, and the Dwight-Lloyd Division of McDowell Engineering Company is building a pilot plant in Cleveland to use its Dwight-Lloyd McWane process.

In all cases, the appeal of direct reduction lies in the chance for lower capital costs. It has been estimated that a 2200-tpd H-iron plant could be built on the East Coast for \$24 million as against \$47 million for a blast furnace of the same size. Direct reduction plants someday might smelt the ore where it is mined—in Canada, Minnesota, Venezuela or where have you. Whether the political implications of this last suggestion are favorable or unfavorable in this time of strong national feeling and threatened restrictive legislation, we leave you to decide.

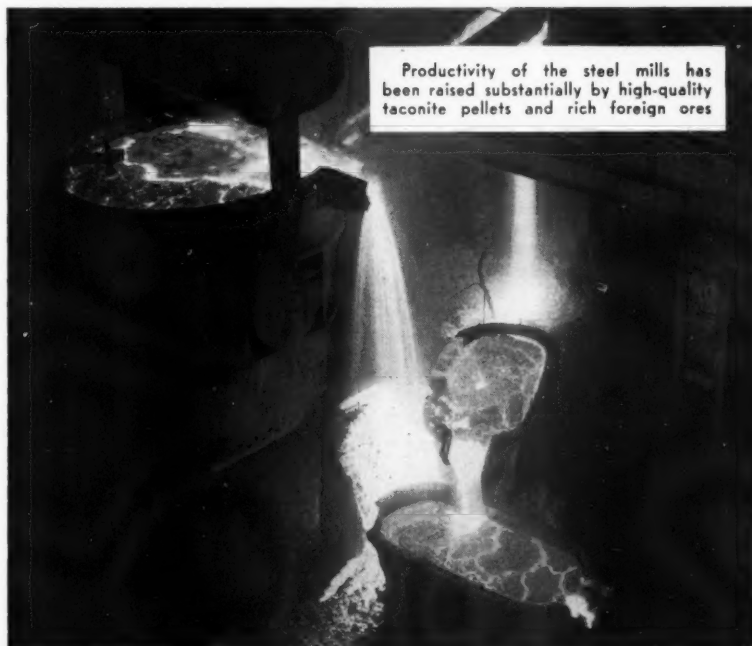
And in the Years Ahead

As this year of change draws to a close, what do we see ahead? Certainly, whether direct reduction comes along or not, there will be continuing and increasing pressure to improve the grade of ore we mine and ship. A study of the world ore market made in the past year documents the point. By 1960, ore consumed in American blast furnaces is expected to average 53 percent iron and will gradually improve in years to come—that's all the ore we use, lumped together, remember . . . be it from Birmingham or Silver Bay or Cerro Bolivar or Bomi Hills or Knob Lake or any place you care to name.

So we will continue to see enormous expenditures for exploration, for development, and for the construction of beneficiation plants. Our Lake Superior ores, which continue to be our most important—and most convenient sources of iron will undergo increasingly extensive treatment. This region, of course, has many advantages as an ore source, and the excitement connected with new foreign deposits should not blind us to this fact.

Reserves, even when compared to some of the astronomical estimates made for other parts of the world, can truly be called enormous. Most of what we now know about beneficiation was, after all, learned in Minnesota and first applied there. The reservoir of technological skill and the background of generations of mining and milling know-how are formidable competitive factors. Finally, such matters as interior lines of communication along the Great Lakes and a stable political environment should not be overlooked when one is evaluating the probable course a future expansion will take.

Both at home and abroad, some new problems became clear during 1957. The need to retain a realistic price structure at home to support the heavy cost of new facilities, plus the need to assure fair treatment abroad, will put new burdens on our industry leaders. Iron ore production has always demanded ingenuity. Now it will call for industrial and political statesmanship of a high order. Nothing less will serve in this time of rapid and unprecedented change which seems to lie ahead.





Asarco's famous old Morning mill at Mullan, Idaho, where outstanding metallurgists and mill men have been cutting their teeth since 1898, burned down in May 1957

Mineral Dressing

The year 1957 recorded important gains on all fronts. The physical processes of separation are being supplemented and in some cases replaced with wet and dry processes that involve chemical and physical change

By NORMAN WEISS

Milling Engineer
Western Mining Division
American Smelting & Refining Co.

ONLY a short time ago we confined our interest in minerals to the simple properties, like specific gravity and hardness, wettability, conductivity and magnetic response. Now, it seems only overnight, we talk of solvent extraction, ion exchange, phase shift, solid state reduction, pressure chemistry, and zone refining. The mineral dresser, extractive metallurgist, and the chemical engineer are learning one another's skills and jointly developing new technologies for the metals we need now and those we may have to scratch for in the next decade.

For example, in Australia a process for the conversion of the titanium

content of ilmenite into rutile is under study, which involves a first step of pyrometallurgy followed by pressure digestion to bring about a phase change; a final low-cost concentration step by conventional milling methods completes the process. As another example, the R-N subsidiary of Republic Steel and National Lead are

in the pilot plant stage of solid state reduction of iron ores followed by physical beneficiation, and this process may also be found applicable to ores of titanium, chromium, nickel, and manganese. Also, International Nickel's technique for nickel-copper separation at Sudbury is a classical example of one hand washing the other, technologically speaking.

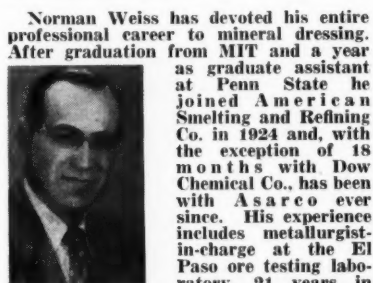
Flotation, we hasten to add, is still the chief tool of the mineral dresser, and its application and sophistication increase each year.

The third International Mineral Dressing Congress was held in 1957 in Stockholm (London 1953 and Goslar 1955). Some of the important

papers will be reviewed here. The high quality of this meeting attests to the fact that Europe is once more contributing generously to the common fund of mineral dressing knowledge.

Important New Plants

The newest mill in 1957 and largest of all times is the Erie taconite mill at Aurora, Minnesota, which started some sections about September first and increased to eight sections (of 27) by November, treating 15,000 tpd of crude ore. Full capacity will be reached about May 1958. A few statistics: total cost over \$300,000,000, annual capacity 22,500,000 long tons of 30 percent iron ore, annual production 7,500,000 long tons of pellets with 64 percent iron.



Norman Weiss has devoted his entire professional career to mineral dressing. After graduation from MIT and a year as graduate assistant at Penn State he joined American Smelting and Refining Co. in 1924 and, with the exception of 18 months with Dow Chemical Co., has been with Asarco ever since. His experience includes metallurgist-in-charge at the El Paso ore testing laboratory, 21 years in Mexico as metallurgist and superintendent of mills, and the past 10 years as milling engineer in Salt Lake City in charge of mill operations and new plant design. A true professional and student in his field, Norman never passes up a chance to help such organizations as the American Mining Congress or to share his broad knowledge in the interest of advancing the techniques of mineral extraction.

Duval Sulfur & Potash Esperanza copper mine is under development in the Twin Buttes area southwest of Tucson, with completion of the 10,000-tpd concentrator scheduled for early 1959. Two identical 5000-tpd sections will be metallurgically independent, and each grinding section will comprise one 12.5-ft diameter by 16-ft rod mill and two 12.5-ft by 14-ft ball mills, with classification in hydrocyclones. A rougher concentrate will be reground and then cleaned, the final concentrate then proceeding to the molybdenite recovery plant.

Lake Asbestos, subsidiary of American Smelting and Refining Co. at Black Lake, Quebec, will complete its 4000-tpd asbestos mill in early summer 1958. Basically the plant is conventional, employing stage crushing, impacting for fiberization, stage screening of rock and fiber, and air classification of products.

Bancroft Mines' new 4000-tpd copper concentrator at Bancroft, Northern Rhodesia, started operation in February 1957 on mixed sulfide and

oxide ore, using 9 ft dia by 8 ft ball mills and 24-in. cyclones. The ore is ground to 75 percent through 200 mesh and thickened before flotation.

Pima Copper Company's new 3000-tpd copper concentrator, which started operations in December 1956 on ore from their open-pit mine, has the distinction of being the first copper mill to rely completely upon hydrocyclones for classification. The cyclone feed pumps, equipped with metal wearing parts, take the mill discharge directly without scalping protection, and the performance has been competitive with tank-type classifiers. The grinding circuit consists of a 10-ft diameter by 13-ft rod mill and two 10.5-ft diameter by 13-ft overflow ball mills, the rod mill discharge being split to two pairs of 20-in. hydrocyclones, each pair working in closed circuit with a ball mill. In the rougher concentrate regrind circuit a 7-ft diameter by 12-ft overflow mill is operated in closed circuit with six 10-in. hydrocyclones. Rod mill feed is 6 percent on 1 in., discharge is three percent on 8-mesh and 29 percent through 200 mesh. The flotation tailing runs 75 percent through 200 mesh.

In January 1957 Inspiration abandoned its unique and classic acid-ferric sulfate leaching practice and switched to its "dual" process, which comprises a straight acid leach for oxide copper followed with regrind and flotation of the washed residue. To do so it was necessary to revamp the old concentrator a mile away, and the result is an outstanding achievement. The change was made because the old process depended upon a certain minimal concentration of ferric ion in the leach solution, and this in turn was dependent upon the production of cement copper. With future reserves tending towards more sulfide and less oxide the correct balance would soon become difficult and impractical.

Quarter-inch residue from the leach vats is hauled to the mill and ground in six 10.5-ft diameter by 14-ft ball mills in closed circuit with rake classifiers. Flotation is performed in 12 rows of 12 No. 66 Fagergren machines, and the rougher concentrate is cleaned without regrind. Slime from washing the leach plant feed is pumped to the mill and separately floated and leached in that sequence.

The new concentrator of Heath Steele Mines, Ltd. at Newcastle, New Brunswick, with 1500-tpd capacity, is the first full-scale mill operation on the copper-lead-zinc ores of this new district.

It is perhaps appropriate to write here the obituary of a famous old mill, Asarco's Morning mill at Mullan, Idaho, which burned to the ground on May 21. Built in 1898, it first em-

ployed the Macquisten skin flotation in 1911 and froth flotation a few years later. By the early '20's it was achieving selective lead-zinc flotation and was among the first to recognize the benefits of middling regrind. Many outstanding metallurgists and millmen cut their teeth in this mill and contributed much to the history and technology of milling.

New uranium plants will be mentioned under "Uranium."

Concept of Coarse Crushing Re-examined

Controlled blasting is stimulating a search for the means to cut the capital and operating costs of massive primary crushers for open pit mines. The use of large "drop-balls" (up to seven-ton) coupled with finer fragmentation in ore-breaking reduces secondary blasting costs and increases the percentage of pit-run material that can bypass these million-pound leviathans. The trend may therefore be directed towards primary crushers of large intake and small capacity, so designed that great stresses are not transmitted directly to the crusher frame, and this will in turn permit a reduction in weight of crusher and mass of foundation.

In the taconite operations, liner wear is so severe that duplicate installations of 54 and 60-in. gyratory crushers are seriously considered to avert costly delays, and in fact Sydvaranger in Norway is now installing a second primary.

Morgardshamars of Sweden has turned out several single-toggle jaw crushers with 55 by 81-in. feed opening, these being considerably larger than any overhead-eccentric crusher made in the U.S. Dragon, of France, has developed the world's largest Blake type crusher, with feed opening 63 by 98.4 in., weighing 275 tons.

Vibrating screens are getting larger too, and of special interest is the new 6 by 14-ft single-deck machine at Butte for screening 2500 tph of copper ore up to 50-in. size at 8-in. separation size. Allis-Chalmers has recently announced a hot sinter screen capable of handling 132 tph at approximately 1400°F. with hot spots to 2400°F. Heat and wear resistant grate sections of high-chrome iron are bolted to pallet assemblies with stainless steel bolts. Side and back plates are of T-1 steel. Frequency is 800, amplitude ¾ in., separation at ¾ in.

The DSM "sieve-bend" screen is gaining interest, particularly as a drainage screen in cyclone heavy-media plants. At American Mining Congress' Salt Lake City meeting Paul Stavenger and V. Reynolds described the new screen, which basically makes wet separations in the 8 to 48 mesh range. Screen wear is

still a problem and operating data are sparse, but initial results show promise. Advantages are high capacity and virtually no blinding.

Larger Grinding Units and More Cyclones

The millman spends a lot of money grinding the ore, so it is reasonable that this phase of mineral dressing continues to hold a glamour spot. The trend towards larger mills is exemplified at Climax (13-ft diameter) and Duval (12.5 ft diameter). In the cement industry there is a growing number of 1500-hp mills, and one company will soon install six 2000-hp compartment mills. These large mills require wide gears and improved lubricants. Balanced two-motor drives are receiving more attention, particularly because the use of hydrocyclones in place of tank-type classifiers has nearly doubled the accessibility around ball mills.

An 18-month testing program at AS&R's Silver Bell concentrator has terminated with the decision to replace spiral classifiers with hydrocyclones in the main grinding circuit. The test section employed a 10 by 10 Lanatex pump and four Krebs D-20 hydrocyclones, but 30-in. classifiers are also under test. While little or no improvement is expected metallurgically, maintenance cost and repair time will be reduced, and operation will be simpler. Pumping cost is estimated to be less than a half-cent per ton. Worn parts are rebuilt at one-third of original cost. Success in pumping is due to low-speed, low-pressure operation (385 rpm 18 ft tdh).

Chuquicamata's changeover to hydrocyclones is an interesting story. At AMC's Salt Lake meeting last September D. S. Sanders said that this change will make room for one additional 10 by 12-ft ball mill to each pair of rod mills, giving them 5 grinding sections each consisting of two rod mills and three ball mills. The 28 to 35 percent on 65 mesh in the present flotation feed will then be reducible to 12 to 18 percent on 65, and furthermore the coarse material will run lower in copper than now. With Pima, Duval, Bancroft, and Silver Bell this will be the fifth important copper ore mill to adopt hydrocyclones for the relatively coarse separation at 48 or 65 mesh. On lead-zinc ores Mount Isa stands alone among the large mills in the use of hydrocyclones in the main grinding circuit.

In the closed-circuit grinding of sulfide ores using hydrocyclones it has been observed that the sulfides are selectively ground about three meshes finer than was the case with gravity classifiers. This is usually advantageous, but the exception is

found when the cyclone rejects barren pyrite for further grinding while finishing low-density gangue-mineral particles that should have had another pass through the mill. In classifying ores that contain metallic and gangue minerals of different specific gravities the cyclone will show greatest superiority over the older classifiers when the specific gravity differential between gangue and minerals is small, and least when the differential is greatest. Accordingly they have been most successful on copper ores and less so on lead-zinc ores with light gangues.

Grinding with ore (autogenous or rock grinding) is gaining ground where iron and steel balls are costly, or in a few cases where metallurgical advantage has been observed. In addition to the older installations at Lake Shore and Neptune we have new examples at Bicroft and other Canadian uranium plants and at the Union Corporation's Grootvlei gold mine on the East Rand. At the latter two 12 by 16-ft rock mills serve as the primary stage of the three-stage scheme with the ultimate product containing 90 percent through 200 mesh. Experiments in which the ore was crushed only to eight in. resulted in important innovations in the design of the new Winkelhaak 2000 tpd mill, started in 1957. A 24 by 36-in. jaw crusher will crush run-of-mine ore to eight in., and the product will be sized plus and minus four in. These two sizes will be rationed to four 12 by 16-ft mills without other grinding media, operated in closed circuit with 36-in. cyclones, and in one stage this circuit will be expected to produce 90 percent through 200 mesh. Six stages of conventional crushing and grinding will thus be performed in two. It is essential that 20 to 25 percent of the mill feed be coarser than four in.

White Pine Copper Company has increased the capacity of two of its six grinding circuits by installing in each of them a 10.5-ft diameter by 14-ft rod mill ahead of the existing 12.5-ft diameter ball mill. These ball mills originally worked in closed circuit with two spiral classifiers each, but in the rod mill sections one of these has been replaced with cyclones while the other serves as a scalper.

The rod mill test at the Kennecott's (Utah Division) Arthur mill is now scheduled to start in early spring 1958. The 10-ft diameter by 16-ft rod mill will compete directly with existing wet rolls, and is installed in such manner that it can be shortened to 14-ft, tested at speeds starting at 57 percent of critical, and fed by either a chute or a scoop. The discharge opening of 60 in. can be reduced.

Grinding Theory Studied

Several interesting papers on grinding were presented at Stockholm. R.

T. Hukki of Finland showed that grinding at supercritical speeds can increase production. At a normal speed of 85 percent of critical and 50 percent ball charge there was little or no slippage of the ball charge and all grinding was accomplished by cataracting, cascading, or attrition within the ball mass. At 240 percent of critical speed using a 15 percent ball-charge the balls did not centrifuge and consequently the degree of slippage was high, creating a zone of intense attrition that indicated a higher capacity potential. This is reminiscent of the 1930 work by Fahrenwald and Lee, who found that maximum grinding efficiency occurred at 130 percent of critical mill speed and with a low ball charge.

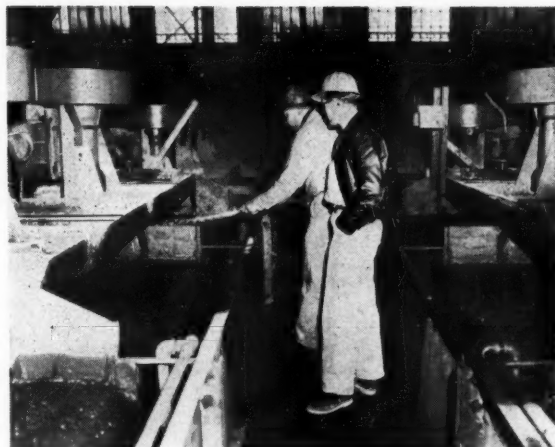
Svensson and Murkes discussed the results of grinding equal charges of the same ore under identical conditions except time, and found that the Rittinger, Kick, and Bond formulae did not fit these results, so they postulated a new form of the Bond equation in which they have replaced Bond's fixed exponent of 0.5 by a variable exponent known as "m". The Bond "Third Theory" has met ever-increasing acceptance for the determination of design horse-power involved in grinding, and among others the Portland Cement Association has now accepted it as standard. Bond's "work index" has been called the most significant parameter in ball milling.

Chrome-moly steel ball mill or rod mill liners are used regularly in at least 15 of the major ore mills and at many smaller operations in the U. S. The high chrome alloys give greatest hardness and best wear, but they lack the toughness and ductility of the austenitic manganese or the low-chrome alloy steel. A whole suite of compositions is available to suit the individual problems. (T. E. Norman in E&MJ July).

Flotation Effects of Slime Coatings

Research into the effects of slime coatings was carried on at M.I.T. from April 1956 to July 1957. Adverse effects are directly related to coating density, which in turn depends upon the properties of the mineral, slime, collector, and solution, and the amount of turbulence. Electrostatic surface charges are also important.

The flotation of galena with KETX was inhibited by slimes of ferric oxide, aluminum oxide, and calcium fluoride, but not of clay or quartz. All inhibiting slimes were positively charged and finer than the negatively charged non-inhibiting slimes. Increasing pH decreased the inhibiting effects of the oxide slimes but not of the calcium fluoride slime. Flotation of sphalerite using dodecylammonium chloride was not affected by ferric oxide slime in an acid solution but was



Flotation is still the chief tool of the mineral dresser, and its application and sophistication increase each year

markedly inhibited in alkaline pulp. Recovery decreased as pH increased to pH 8 to 9 and then increased again up to pH 10 to 11. The minimum recovery corresponded to maximum density of ferric oxide slime coating.

At Bathurst, N. B., Brunswick Mining and Smelting Corp. has completed nearly three years of pilot plant and laboratory research on the flotation of complex copper-lead-zinc ores from two orebodies under development. Selective flotation is complicated by the unusual intimacy of the sulfides, and very fine grinding is needed to produce acceptable copper, lead, and zinc concentrates. More will be heard of this difficult metallurgical problem.

Dual processes on copper ores are being applied at Bagdad (flotation of sulfides followed by pilot-plant roasting and leaching of the concentrate and generation of acid for dump leaching), Inspiration (described earlier), and Hayden (leach precipitation-float). Research at other copper mills promises future process elaboration of the same kind when the metal markets pick up again.

At Anaconda improved ore mixing has improved the flotation operation, and an automatic lime titrimeter is under test. The new Dow reagent Z-200 recently adopted shows strong collector affinity for copper and zinc minerals but little for pyrite in lime-alkaline pulps over pH 9.5.

Automatic control of flotation by residual xanthate concentration and alkalinity, as described by Malnarich and Bushell in 1956, will be given exacting tests in Consolidated Mining and Smelting Company's new pilot plant, expected to start up early in 1958. Continuous tailing assay by X-ray fluorescence will be another feature of the small mill. Such use of a pilot plant to prove up instrumentation and automatic controls is a relatively new development in the mineral industries, though long a standard procedure in the chemical industry.

Among the valuable papers presented at Stockholm was one by Per Kihlstedt of the Royal Institute of Technology (Stockholm) on flotation with talloil-fuel oil emulsions and a description of his pilot plant facilities for work on hematite and apatite. Of great interest also was a report by the Russians, Konev and Debrivnaja, on techniques developed at the Leningorsk concentrator for desorbing flotation reagent from a lead-zinc bulk concentrate, employing pilot plants of 300 and 1500 tpd capacity. Ten percent sodium sulfide solution is used in three conditioning stages to displace the collector from the metal sulfide surfaces. Then the concentrate is dewatered and reground to 90 percent through 200 mesh, and cyanide and zinc sulfate are added to "complex" any remaining collector. Recoveries and grades were improved and costs dropped 25 percent compared with a selective flotation procedure.

S. C. Sun and R. T. Holzman (Anal Chem v. 29 Sept 1957) experimentally determined the correlation between polarographic readings and Xanthate concentration in flotation liquors, and demonstrated that the method, with 3 percent variation, is sufficiently accurate for the ordinary research in sulfide flotation. A new approach to fine particle measurement (Ind & Eng Chem v. 49 July 1957) is the Coulter electronic counter, which in 10 minutes or less will obtain data for a 10-point distribution curve of frequency vs. size, handling particles over a size range of at least 20 to 1. For example, a 100-micron orifice could count particles between 3 and 60 microns.

A paper on iron flotation on the Marquette Range by Emert W. Lindroos was presented at the Tampa AIME meeting in October. Two plants, Humboldt and Republic, are currently floating specular hematite ores containing relatively small amounts of magnetite and martite,

with total capacity of 300 1tph. Ore is first ground to 48 mesh and the very fine material, three or four percent of the total, is wasted. The rest is conditioned with fatty acid and MIBC frother, then floated at natural pH of 7.2 to 7.7. A 40 percent ore is upgraded to 64 percent with 90 percent recovery. On the Mesabi Range, Jones & Laughlin are the first to install a full size flotation plant, treating tailing pond material near Calumet.

The vast changes that have come to flotation in 25 years are realized if one compares the two editions of Gaudin's "Flotation", first published in 1932 and republished this year after complete rewriting. The earlier book was predominantly concerned with the *art* while the present edition establishes a widening *scientific* base and a growing technology.

Gravity and Electrical Methods Find New Applications

The Cannon Concentrator was described at the Tampa AIME meeting in October. This is a circular arrangement of 48 pinched sluices designed specifically for the concentration of heavy minerals from Florida beach sands containing ilmenite and rutile, but it has also been tested on reagentized phosphate ore. One company has designed a new heavy mineral recovery plant around the Cannon concentrators and will install these right on the dredge, thereby eliminating the separate wet plant that up to now has been conventional.

Spherical ferrosilicon, developed by Knapsack-Griesheim in Germany several years ago and bought by about 90 percent of European users of ferrosilicon, is finally winning attention in this country. Although it improves medium recovery and density control it is commercially used by only one company in the United States. The spherical ferrosilicon permits a higher operating density (S.G. 3.4 to 3.5) without the usual penalty of excessive viscosity.

High tension separation has been used successfully in recent years in the beneficiation of complex suites of heavy minerals, but this year it was extended to iron and tungsten ores. On iron ores such as specular hematite, martite, and magnetite the separation from silicious gangue involves nothing more than a separation of conductors from non-conductors. Tests are showing concentrate grades of 65-68 percent iron with 90-95 percent recovery. Operating costs are estimated at 4 cents per ton of feed but capital cost is higher than with conventional equipment.

High tension concentration of scheelite involves only drying and conductivity separation, as contrasted with today's practice of floating sul-

fides and roasting the scheelite concentrate, then subjecting the latter to magnetic separation. Some scheelite ores have been concentrated to 77 percent WO_3 with 98 percent recovery of WO_3 .

Uranium Ore Milling

This subject alone merits its own review and we propose to note here only a few important developments. At this writing fifteen uranium mills are operating in the U. S. and nine more are in construction or contracted. Total ore milling capacity is approximately 20,000 tpd and the estimated total plant cost is about \$130,000,000 equivalent to \$6500 per ton of daily ore capacity. In Canada the Gunnar, Lorado, Algom, Faraday, Pronto, Stanrock, Stanleigh, Milliken Lake, Panel Consolidated, Con-Met, Denison, Lake Nordic, and perhaps others also, went into operation in the past year, and in Australia the Mary Kathleen.

Solvent extraction has gained ground over solid resins. Vitro is the last to put in phosphate precipitation for recovery. Union Carbide Nuclear, Gunnison, and Texas-Zinc, the first two using di (2-ethylhexyl) phosphoric acid and the last using a secondary amine for extraction, were nearing completion late in 1957. Texas-Zinc is stripping with ammonium nitrate in Podbielniak centrifuges.

Kerr-McGee at Shiprock has shelved their column exchange in favor of solvent extraction on all solution. Dawn, at Ford, Wash., went into operation with column exchange, and the Lucky Mc at River-ton, Wyo., will do the same.

The acid leach resin-in-pulp plant of Western Nuclear started operation. Uranium Reduction, now employing acid RIP, continued to explore alkaline RIP for high-lime ores. Union Carbide Nuclear's new mill at Maybell, Colo., will study the Inflico-Techmanix system of continuous ion exchange, using airlifts to advance the resin.

For Ambrosia Lake Ores in New Mexico alkaline leach mills are being built by Homestake-Sapin, Homestake-New Mexico Partners, and Phillips. Vanadium Corporation of America's wet attritioning plant in Monument Valley is the only "upgrading" mill on the Plateau, but Union Carbide Nuclear will upgrade by flotation in plants now being built at Slick Rock, Colorado, and Green River, Utah. Concentrates assaying about one percent U_3O_8 will be produced by combination of carbon flotation, attrition grinding, and acid leaching.

In the laboratories AEC's Winchester research group demonstrated that the cupric-ammonium complex

ion had important possibilities as an oxidant in alkaline processing, and the Salt Lake City station of the Bureau of Mines found that aeration of the neutral pulp before acid addition would reduce the cost of oxidants in acid processing, and also found promise in an amine-organophosphate combination extractant for uranium and vanadium from acid liquors.

Improvements in Iron Ore Pelletizing

The combination of traveling grate and kiln, an adaptation from the AC-Lellep system used for making cement clinker, is improving iron ore pellets by virtue of increasing the fuel efficiency and the hardness and toughness of the pellets. Fines resulting from the ASTM tumbling test run less than five percent. On magnetic taconite concentrate fuel consumption of only 700,000 to 800,000 BTU per net ton of product is reported.

Direct reduction of iron ores is becoming increasingly important for producing a substitute for scrap or high grade lump ore in open hearth and electric furnace plants. These processes will also make it possible for coke-poor regions of the world to produce steel and for countries with an excess of iron ore to export reduced iron instead of ore. Excellent reviews of this new technology were presented in *E&MJ* and *Mining Congress Journal* December 1957.

Reduction of the non-magnetic iron ores of Minnesota and Michigan to magnetite, so that they may be cheaply concentrated by magnetic separation, is one of the most promising possibilities of beneficiating these

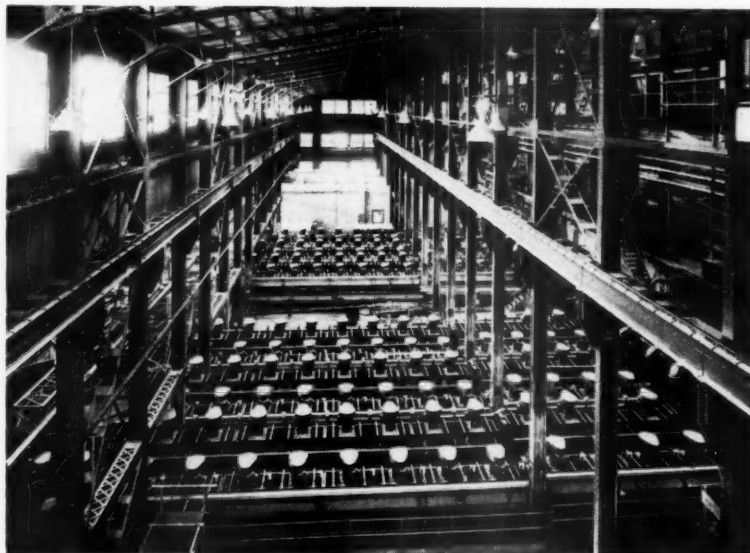
difficult ores. Cleveland-Cliffs has been operating a three-ft experimental fluosolids reactor for the past year, and the Jones and Laughlin laboratory at Negaunee has conducted a similar research.

For the Future

The signs portend that the economic millstones will do their share of the grinding in the next year or two. In times like these, laboratory research is more likely to proceed at full speed, while the new applications of principles and processes may be set aside because they require much larger capital expenditures and because they often result in greater production just when production must be curtailed rather than increased. It is logical to expect that the next year or two will be studded with advances in the science of mineral dressing and extractive metallurgy, but that technological progress will proceed at a slower pace.

The main trends exhibited in the last few years and continued through 1957 were in the direction of larger grinding units, wider application of rock grinding and hydrocyclone classification, and a general broadening of the mineral dressing foundation by addition of wet and dry processes involving chemical and physical change.

We should like to acknowledge the help that the following kindly provided: E. H. Crabtree, Bruce Clemmer, Fred DeVaney, F. E. Bridger, Jr., Will Mitchell, J. Hall Carpenter, Don Drinkwater, S. E. Erickson, Bill Marston, Chet Rowland, H. R. Spedden, L. H. Lange, Howard Zoerb, F. R. Salter, and others.



In January 1957 Inspiration abandoned its unique and classic acid-ferric sulfate leaching and switched to a straight acid leach for oxide copper followed with regrind and flotation of the washed residue. Pictured is the flotation section in the new mill

Expanding Markets Are Key To Cement Industry Growth

By JOSEPH S. YOUNG

President
Lehigh Portland Cement Co.

Joseph S. Young has more than 32 years experience as an officer of Lehigh Portland Cement Co. It was shortly after graduation from Columbia Law School in 1923 that he entered the employ of Lehigh. He was subsequently elected a vice-president in 1926, a director in 1931, and president of the company in 1932. During World War II he was a member of the Cement Industry Advisory Committee of the War Production Board. Young is an officer of several other companies and former chairman of the board of the Portland Cement Association.



During 1957 the cement industry experienced a slight decline in shipments, largely attributable to transitory factors. But expanding markets and an anticipated increase in overall construction volume point to increased shipments in 1958

A RAPID growth in the newer structural types of concrete, such as precast and prestressed units and thin shell roofs, was perhaps the most important development in the use of cement in 1957. Shipments of cement were down slightly from 1956, largely due to bad weather which slowed the beginning of the construction season, and a strike which affected most of the larger producers. But expanding markets and an anticipated increase in overall construction volume point to increased shipments in 1958.

Shipments in the twelve months ending September 30, 1957, were 288,280,000 bbl, according to the Bureau of Mines. This was a five percent decline from the 304,188,000 bbl shipped in the preceding 12 months.

Despite this decline in shipments, the industry continued its large-scale expansion program in anticipation of growing future markets. According to the Bureau of Mines, there were 161 portland cement plants in the United States and Puerto Rico with a combined annual capacity of three hundred fifty-seven million bbl as of July 1957. This compares with a capacity of three hundred nineteen million bbl one year earlier.

Forecast for 1958—Five Percent Increase

The construction industry as a whole continued at high levels during 1957, although it did not maintain its rate of growth of recent years. Figures released by the Departments of Commerce and Labor show that the dollar volume of construction rose about two percent over 1956, to \$47.2 billion. The forecast for 1958 is an increase of about five percent. Because of a continuing rise in construction costs, the 1957 increase represents little change in volume.

The optimism of the cement industry in the face of a slackening of the growth of construction is based on a number of factors. First is the long-term need for housing, factories, offices and public facilities for a rapidly growing population. In the shorter term, there are the huge federal high-

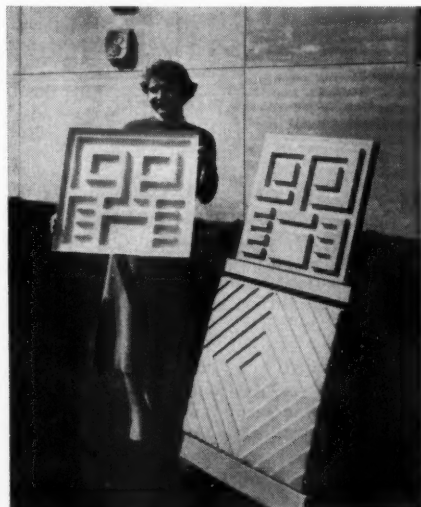
way program, now getting into the construction phase, and the tremendous backlog of sorely needed public facilities such as schools, water supply and sewage treatment plants. Finally, there are many new uses of cement and concrete that are obtaining wide acceptance, and continued expansion of markets is promised by a high level of research and development activity in laboratories and the field.

Rapid Growth of Precast and Prestressed Concrete

No more spectacular change has occurred in the construction industry in the United States since World War II than the rapid and widespread acceptance of precast and prestressed concrete. The number of plants producing prestressed concrete units has grown from one in 1950 to some 275 today, according to trade publications. It would be difficult to find any industry requiring comparable investment in plant and facilities that has grown at this phenomenal rate.

A survey made late in 1957 revealed that in the first nine months of the year nearly 900 prestressed bridges and some fifteen million sq ft of prestressed roof and floor units had been awarded or built. More than 90 percent of the bridges and practically all the floor and roof units were factory-produced. The increase over 1956 was well over 50 percent.

The World Conference on Prestressed Concrete, held in San Francisco in midsummer, focused the engineering world's attention on this superbly efficient building material. Some 1200 delegates from throughout the world attended the conference to



New applications which utilize the adaptability of concrete continue to increase its use. For example, the girl is holding a plastic mold which makes production of the decorative concrete panels next to her possible

exchange ideas and techniques. It was generally agreed that despite its rapid growth, the use of prestressed concrete has only reached a fraction of its potential. One prediction for the near future was that joists, beams, floor and roof units would be carried in stock by warehouses and as easily obtainable as standard steel shapes.

Tilt-Up Walls

Another method of precasting, of somewhat more limited application, has also been making rapid strides. In the first nine months of 1957, more than 1500 buildings were awarded or constructed using tilt-up wall panels. This was 20 percent more than were built in all of 1956.

Of great potential importance to the future of tilt-up and other forms of architectural concrete was the development of plastic and rubber form liners during 1957. These liners make practical a wide variety of attractive patterns and textures at low cost. The plastic liners produce crisp, sharp patterns and almost glassy surfaces suitable for both interior and exterior walls, as well as facings for concrete block. Rubber liners produce textures that make a beautiful, acoustically effective ceiling out of the bottom surface of a flat-plate floor, or an interesting textured wall pattern. The form liners are expected to substantially increase the use of concrete walls for many types of buildings.

Lightweight Aggregates

A marked trend toward the much wider use of lightweight aggregates in structural concrete has been apparent in the last five years. This is especially true of precast units whose transportation cost is an important factor. A recent development is the application of light-weight aggregates to prestressed concrete. The advantage this would bring in the reduction of deadweight of relatively long span members is obviously great, and considerable research is now being done by various agencies on a wide variety of lightweight aggregates.

Ready-Mix and Block

Ready-mixed concrete and concrete block—the concrete products industries that are utilizing a growing amount of the output of the cement industry—held their own in an increasingly competitive market. The latest figures available cover the year 1956. Both industries showed growing production despite a slump in homebuilding.

From the results of several surveys, industry sources estimate ready-mix production at 90,000,000 cu yd, an increase for the sixth consecutive year.

Estimates of the production of concrete masonry in 1956 were 2.15 billion eight-in. equivalent units. Block



Prestressed concrete was chosen on the basis of economy and construction speed for some 250 bridges on the Illinois Toll Road. Two grade-separation structures are being erected here

accounted for about two-thirds of the volume of all masonry walls constructed during the year, and continued its increasing dominance in the masonry field.

Computers Ease Design Work

The growing use of electronic computers in the construction field will enable designers to take greater advantage of concrete's moldability to fit exactly any pattern of stresses, without waste or excess material. The difficulty of designing such structures as thin-shell roofs and concrete arch dams has in the past limited their use, even though they may have been the most satisfactory and economical alternatives. Freed of tedious and time-consuming computations, designers will be able to compare all possible alternatives and choose the most economical structure. This will almost certainly increase the use of structural concrete.

Federal Highway Program

The \$50-billion Federal-Aid Highway Program, enacted in mid-1956, began to gather momentum in 1957. Although the program is expected to account for very large construction outlays in future years, much of its current effect is confined to preliminary engineering and right-of-way acquisition. Nevertheless, highway expenditures are estimated by the Departments of Commerce and Labor to have increased by some eight percent in 1957, and a further increase of 14 percent is predicted for 1958.

During the first ten months of 1957, awards of concrete pavement of all types totaled 78,640,000 sq yd, a 7.8 percent increase over a similar period in 1956. Awards of concrete pavement for roads, reflecting the impact of the highway program, showed a 13.8 per-

cent increase.

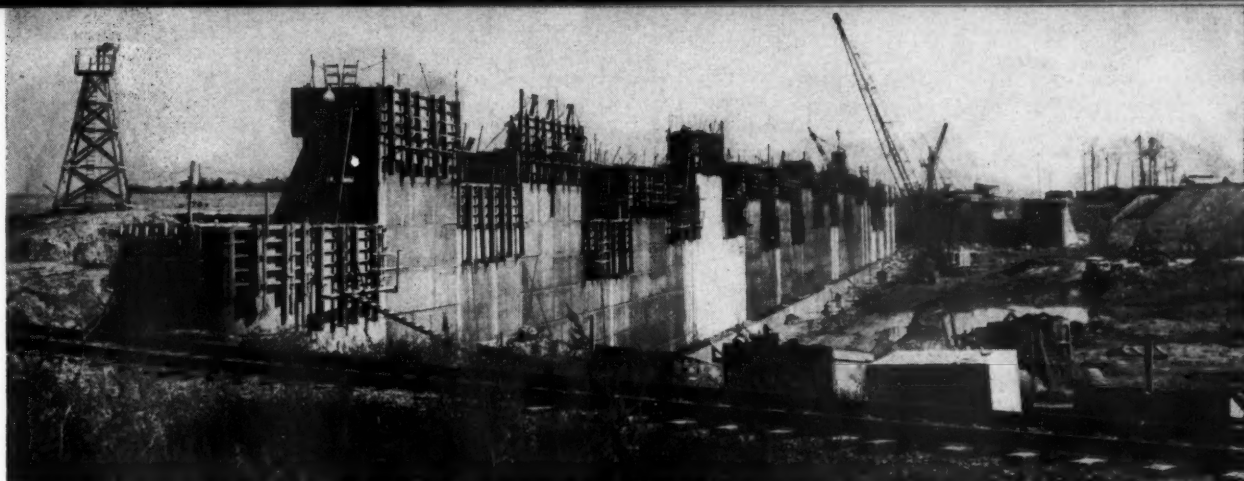
Awards of soil-cement pavement for all uses during the first 11 months of 1957 totaled some 24,000,000 sq yd. This was a 22 percent increase over 1956, and continued the rapid growth of this relatively new paving material. The increased pace of highway construction was also reflected in soil-cement awards, where road yardage rose by 42 percent. Continued improvement in construction methods was dramatized by a new record of 2½ miles of soil-cement road built in one day on a large project in Michigan.

An event of great importance to the future of highway construction in 1957 was the placement of the first pavement on the National Test Road near Ottawa, Ill. This test road, to cost some \$22,500,000, is sponsored by the Bureau of Public Roads and the various state highway departments. It will be used to evaluate various pavement designs and materials. Paving is expected to be completed next spring, and traffic tests will begin next summer. This test of road performance, the most comprehensive ever undertaken, will undoubtedly provide the basis for pavement designs of the future.

Other Major Markets

The rapid postwar growth in population has created a large backlog of needed public works projects. These include water supply and sewage treatment facilities, schools and hospitals, and urban redevelopment programs.

Major impetus to construction of needed sewage treatment facilities throughout the nation was given by the Federal Pollution Control Act of 1956, which authorized federal expenditures of five hundred million



Major markets for concrete during 1957 included such projects as the billion-dollar St. Lawrence Seaway and Power Project. Pictured above is a portion of the Eisenhower Lock

dollars over a 10-year period. In its first year, the program stimulated one hundred and sixty seven million dollars worth of sewerage construction with federal grants of thirty eight million dollars. Construction of sewerage facilities increased 12 percent in 1957.

Other types of public building showed similarly large gains. School and hospital building were both up 11 percent, and all types of non-residential public building gained an average of 10 percent during the year.

In the field of resources development, the most spectacular undertaking continued to be the billion-dollar St. Lawrence Seaway and Power Project. Work progressed rapidly on the many structures involved in the project, which will open the Great Lakes to deep-draft shipping and provide nearly 13 billion kw of power annually.

The largest concrete dam in many

years was awarded to contract in 1957. It is the Glen Canyon Dam, the first of a number of major dams slated for construction in the seven hundred and sixty million dollar Upper Colorado River Project. A concrete arch structure 700 ft high, the Glen Canyon Dam will be second only to Hoover Dam in height. The 4,770,000 cu yds of concrete required for the dam structure will make it the nation's third largest in concrete volume.

Two construction projects of special interest to the cement industry were begun in 1957. The American Concrete Institute began construction of its new headquarters building in Detroit, and the Portland Cement Association started erection of two new buildings at its Research and Development Laboratories in Skokie, Ill. All three buildings will, in themselves, demonstrate some of the most important new concrete design and construction techniques, as well as

providing needed facilities for an expansion of the activities of these groups. The buildings also demonstrate the confidence with which the cement and concrete industries are planning for the future.

Expect Steady Growth

The cement industry, in general, remained confident during 1957 despite a slight slump in shipments, largely attributable to transitory factors. The forecasts of construction activity prepared by the Departments of Commerce and Labor indicate an increase in shipments of cement in 1958. Added to this is the strong competitive position of the industry due to many important advances in concrete construction in recent years. Although the postwar period of very rapid expansion is probably over, the industry looks forward to continued steady growth of markets and shipments.

MECHANICAL MINING

(Continued from page 66)

this manufacturer. The growth in sales of this type of equipment has warranted the inclusion of such a category in the Annual Report of Coal Mining Equipment sales by the USBM. In 1957 two new types were added to this line, with the drive units placed at the discharge section instead of the receiving section. One of these new types has tandem drive units designed to handle the surges encountered in continuous mining.

This manufacturer also introduced in 1957 a rope belt conveyor which features 27° auto-tilt idlers for the purpose of automatically training the belt in either direction of travel.

Also recently developed is a high capacity auxiliary conveyor designed to achieve maximum load capacity in mine cars and to prevent stoppage of coal flow from the face while cars are being spotted. The boom operator need only reverse this conveyor until the car has been positioned.

In general, the coal industry is fortunate in having the invaluable assistance of an unusually alert and progressive group of equipment manufacturers. Almost without exception the individual members of this group have displayed keen interest in helping to solve the major production problems of today and to anticipate those of tomorrow.

Outlook

The foregoing listing of recent developments, lengthy though it appears, is actually far from complete. Regretfully the writer offers his apologies for the omission of interesting developments for which space in this article is not available. It is understandable that in an era of swiftly moving developments in design of equipment that there may be a tendency of production management to defer expenditures for mechanization today because of the possibilities of sweeping advances that may be made within a comparatively short time.

Another consideration which stresses caution is the terrifying effect of mounting interest and depreciation charges, especially during periods of slack demand such as have repeatedly been encountered in the coal industry.

However, notwithstanding frequent discouragements and occasional pitfalls, the coal industry is not destined to become an anachronism within the foreseeable future. The financial strength of important segments of the industry and the courage of its leadership in making substantial investments in properties and equipment indicate forthcoming stabilization in the industry that even a decade ago would have seemed unattainable.

Notwithstanding temporary setbacks in production as at present, the longer term prospects for the coal industry are for increasingly greater success in the struggle with competitive fuels for a substantial share of available markets, because of continued advances in design and utilization of mechanical appliances and equipment.

1957 Annual Review Of Strip Coal Mining

The trend was toward larger and more efficient equipment as strip mining accounted for more than 25 percent of the bituminous coal production in the United States

By G. H. UTTERBACK

Secretary-Treasurer,
United Electric Coal Companies

IT is common knowledge that Louis Joliet and Father Marquette made journeys of exploration along the Mississippi watercourse during the latter part of the seventeenth century and their records comprise an important chapter in our early history. Early in 1673 they left Green Bay in what is now Wisconsin, travelled westward along the Fox and Wisconsin rivers to the Mississippi, thence southward

along the "Father of Waters" to the Arkansas River, arriving there in July. On their return trip they left the Mississippi and paddled up the Illinois River. Somewhere near the present city of Utica, Ill., they made note of the presence of coal (Charbon de terre), the first authenticated record of the finding of coal in North America.

One hundred and thirty seven years

later the first recorded shipment of coal from Illinois was made when a flatboat was loaded on the Big Muddy River near the present city of Murphysboro and floated down-stream to New Orleans. The first coal mined commercially in North America was in 1745 near Richmond, Va., and the first coal strip mined was near Danville, Ill., in 1866.

In 1957 the strip mining method was again responsible for something over 25 percent of the bituminous coal production in the United States. The first coal strip mining was done by hand and/or horse drawn equipment such as scrapers or hand-loaded wagons and the story of growth from one horse power stripping to the present day machines utilizing 3700 hp is one that merits the writing talent of a Hemingway.

The key to successful strip mining has always been and will continue to be in the ability to remove the overburden from the coal. As potential strip coal reserves have been mined out and the overburden to coal ratios have increased, larger and more efficient equipment for drilling, blasting and stripping has become necessary.

At the present time five stripping shovels of the 60 cu yd or greater capacity are operating and one other is being erected. Numerous walking draglines with 30 and 35 cu yd buckets are working as primary and auxiliary stripping units as well.

Three Kolbe wheel excavators are operating in the Illinois field, another is being erected, and one other wheel excavator of the Kolbe type also is working in Illinois. The wheel excavator works as an auxiliary machine, removing overburden in conjunction with a stripping shovel, the "wheel" removing the top part of the bank. Both wheel and shovel are crawler



Tall as a 12-story building, this stripping shovel can scoop up 70 cu yd of overburden in a single bite

mounted and travel on the coal seam. The wheel excavator has been an extremely useful high capacity machine in the Illinois field because of the necessity for placing the largely unstable portion of the bank far enough away to keep the spoil bank surcharge at a minimum. At least two improvements developed on the Kolbe wheel excavator are now being used on the German wheels.

While the large new stripping machines headline the spectacular breakthroughs for the industry, the tried and trusted equipment of earlier development continues to move probably 90 percent of the overburden. Shovels and draglines of capacities ranging from 10 to 40 cu yd working around the clock combine to make strip coal mining the largest materials handling business in the world.

Drilling and Blasting

The most remarkable innovation in the strip coal mining industry in the past several years has been the use of ammonium nitrate compounds as a blasting agent for shattering the rock strata overlying the coal seams. With ammonium nitrate as the base component and comprising up to 90 percent of the compounds, additional fuels such as kerosene, fuel oil, carbon black or coal dust are added to produce an efficient, insensitive explosive that has had a very wide acceptance. One company adds five percent nitromethane to produce a cap-sensitive explosive. The development of this explosive, coming as it did, on the heels of the high speed rotary air blast drill, has made possible the operation of properties otherwise uneconomical.

One high speed rotary air blast drill with a 90-ft mast makes possible the drilling of an 80-ft hole without the necessity of removing or replacing drill stems.

Truck Size Constantly Increasing

The latest and largest haulage unit is one of 81 ton rated capacity now in use in central Illinois. This unit is powered by a 375-hp diesel engine



Intelligent reclamation programs are now in operation in all states where strip mining is carried on extensively

reputed to be the first V8 diesel engine made in this country. Another innovation is the combination air hydraulic suspension system on both tractor and trailer. The same type of suspension is also used on the tractor-trailer connection to cushion the shocks in loading and hauling.

At least three other manufacturers are now making 70-ton units. The first haulage trucks designed and built especially for the strip coal industry in the middle 1930's were generally of about 20 ton capacity. Truck haulage provides a flexibility of pit operation not obtainable in any other way. The constantly increasing size of truck equipment has been made possible largely by the development of pneumatic tires capable of withstanding the shock loads and heat generation. The 50-ton units, now quite commonplace; the 70-ton units just coming into use; and brand-new 81-ton units are all outstanding examples of equipment that has been specifically engineered for the strip coal mining industry.

Heavier equipment and payloads have made careful attention to road construction necessary. More substantial subgrades together with planned gradients and curvatures enable the mammoth machines to operate at their best efficiency.

Sprinkling of roads with water to allay dust continues as standard practice and most companies have special equipment to accomplish the task at minimum cost.

Loading

The loading shovel, always the dependable work horse of the industry, continues to perform its duties efficiently and without the fanfare that accompanies achievement in other phases of strip mining. Loading dippers up to ten cu yd capacity are to be found in many of the larger operations where correspondingly large haulage units make the large dippers practicable.

Stockpiling at Preparation Plant

Continuity of operation between the loading shovel, haulage units and preparation plant without using an excessive number of haulage units has long been a problem of considerable importance in the stripping industry. Stockpiling at the washing plant is an obvious answer and one that is coming more and more into use. One Indiana operator now has hopper facilities for storing 3500 tons after it has been processed through a Bradford breaker, thus, to a large extent, freeing the pit and haulage operations from the necessity of uninterrupted plant operation and vice versa. Another company in west Kentucky has gone a step further and provided a storage pile of washed coal at its barge loading terminal.

G. H. Utterback became associated with the strip coal mining industry in 1930 as an engineer for the Enos Coal



mond, Va.

Gene Utterback left Enos in 1944 to serve as technical advisor to the British Ministry of Fuel and Power on its open-cast coal mining program in England. Later he served three years as mine superintendent in Tennessee. In 1948 he joined United Electric Coal Companies.

Mining Co. His connection with coal mining is not without precedent, however, as one of his ancestors came to Virginia in 1710 and worked in the iron and coal industry there. It is entirely possible that the elder Utterback had something to do with the first coal mined in North America in 1745 near Rich-

Reclamation and Land Use

Early efforts towards reclamation of stripped-over land were confined largely to reforestation projects in each state and usually in cooperation with some state organization. While tree planting is still an important part of the reclamation now being carried on, particularly in areas that were not arable before stripping, more and more attention is being given to the creation of grazing lands for stock farming and agricultural production. Scientific planting and fertilization programs begun in the late 1930's have demonstrated their practicability where land values warrant the added cost of levelling.

Of the 85,000 acres that have been affected by strip mining in the state of Illinois, 43,467 acres have been reclaimed for one use or another, and over 6000 acres of the total are restored to the point where farm machinery can be used in their cultivation.

Intelligent reclamation programs are now in operation in all states where strip mining is carried on extensively, the object being to relate the ultimate use of the restored land to its most practicable function.



Development of pneumatic tires capable of withstanding the shock loads and heat generation played an important role in the constantly increasing size of trucks

A Trying Year for LEAD AND ZINC

With excessive foreign imports,
Government policies need to be
changed to assure a healthy
domestic lead-zinc industry

By CHARLES E. SCHWAB

Assistant to the President
The Bunker Hill Co.

FOR comparative purposes a review of 1957 may conveniently be divided into the first half and the second half which will bring into sharp focus the extreme contrast between these two half-year periods.

The first half year was characterized by steady prices of 16 cents for lead and 13½ cents for zinc as the U. S. barter and stock pile acquisitions, carried forward from 1956, continued to absorb the very substantial surpluses of world mine production outside the United States. Industrial consumption was at a good level, producers stocks were not excessive. This country's mine production, while not recovering to its 1951-1952 level, did maintain steady output during the first half of 1957 at an annual rate of 354,000 tons lead and 575,000 tons zinc.

However, with the announcement of the cessation of barter in May and the subsequent announcement by ODM that defense stock pile objectives were nearly met, radical changes occurred in the second half of the year.

In striking contrast, during the last six months, prices plummeted, producers stocks sharply increased, sales lagged and U. S. mine production declined as many operations were closed or curtailed. In the closing months of the year the general slowing down of industrial activity and the widespread prediction for a comparatively slow first half of 1958 further accentuated problems of domestic producers, particularly the mines, whose profits had already declined drastically or disappeared altogether.

Imports for consumption into the United States, however, were at near record-breaking levels. During the first eight months of 1957 zinc was being imported at an annual rate of 870,000 tons and lead at an annual rate of 510,000 tons. It now appears that zinc imports will exceed all prior records and lead imports will approach the record-breaking level of 1952. As of mid-1957 it was estimated that the annual free world mine production was exceeding free world industrial consumption by about 300,000 tons for zinc and \$175,000 tons for lead. This excess mine production from operations outside the United States, without barter, broke the world market price. With

the present inadequate tariff schedules, the U. S. price followed this decline.

Producers Seek Higher Tariffs, Import Quotas

During the year, attention centered on the domestic producers efforts to obtain some measure of protection from, and control of, unneeded imports and the effect of excess foreign mine production.

In June, as a part of the Administration's long-range mineral policy, Secretary of the Interior Seaton forwarded to the Congress a bill providing for a sliding scale of import excise taxes beginning below the "peril point" of 17 cents for lead and 14½ cents for zinc. Despite the inadequacy of the proposed schedule of excise taxes, this bill did enable the House Ways and Means Committee and the Senate Finance Committee to hold hearings. Subsequently a bill was reported out of Senate Finance Committee and was on the calendar at the close of the session in late August. However, the Chairman of Ways and Means (Honorable Jere Cooper) addressed a letter to the President in behalf of himself and his party's colleagues on the committee which, while affirming the distressed condition of the domestic lead-zinc industry, cited the powers which Congress had given to the Executive Department to correct such conditions by administrative action. The President in his reply of August 24 advised the chairman that if the Congress failed to pass the needed

(Continued on page 92)

As chairman of the Emergency Lead-Zinc Committee, Charles E. Schwab is particularly well-informed on current aspects of lead-zinc production. Schwab's present position as assistant to the president of the Bunker Hill Co., and his professional background, also afford him the qualifications to write an informative article. His professional history may be briefly summarized as follows: 1937—graduated from Ohio State with a B.E.M. degree, followed by underground work in the Gogebic Range and openpit exploration work in Texas . . . 1939—became engineer with the Western Division of Basic Refractories followed by promotion to division manager . . . 1944—undertook varied duties in engineering, supervision and industrial and employee relations for Bunker Hill. Last fall he was promoted to his present position.





ADVANCES IN OPEN PIT MINING

Open pit mining in 1957 was characterized by the development and use of new equipment and methods, which have aided operators in solving problems, improving operations, increasing efficiency, and reducing or at least resisting the constant pressure of rising labor and supply costs

By **HUGH J. LEACH**

Manager of Minnesota Mines
Cleveland Cliffs Iron Co.

IMPORTANT developments continued in drilling by the use of rotary and air-powered percussion drills, and ammonium nitrate blasting agents found increasing acceptance. Advances in shovel and truck design continued to the point where there are units available of such size and design as to fit almost any operation, large or small, and suitable for almost any conceivable operating condition. Advances in design of accessory equipment—tractors, graders, rubber-tired and crawler-mounted loaders—furnished mine operators with a wide range of highly useful tools to perform auxiliary tasks quickly at low cost. The problems of choice of equipment and method of use still remain with the mine operator, but there certainly is no lack of well-designed, efficient machinery to do almost any job, and the effect of this on mining operations is obvious. Allowable stripping ratios have been increased; open pits are economically deepened; mining methods have improved and will improve further as new machinery and new applications are developed.

Over the years, there have been gradual improvements in mining

equipment design and a few spectacular advances such as the substitution of electric power for steam in shovels and the replacement of rail haulage with truck. But not in many years has there been an advance in equipment and its use that compares with the developments that are currently going on in the art of drilling blast-holes. Churn drilling in many of the larger pits has been replaced, in whole or in part, by rotary or percussive tools powered by air.

The rotary was first introduced several years ago for drilling softer rocks found in quarries and coal stripping operations, but the development of carbide-studded roller cone bits brought wide acceptance in almost every type of open pit mining. Its use, aside from capital cost consideration, is limited only by rocks of such hardness that bit cost defeats its otherwise efficient performance. Rotary drills are now available for hole sizes up to 12 in. Lighter models are truck or tractor mounted, whereas the larger sizes are mounted on heavy duty crawlers.

Percussive drilling was running second until 1956 when several manufacturers developed down-the-hole drills

which caught the attention of all miners. Cuttings are air-flushed, and efficiency, due to elimination of the long drill rod, is increased over previous drills to the point where percussion drilling is again very competitive—particularly in the harder rocks. Although drills are presently limited to 6½-in. hole size, at least one manufacturer has an experimental 9-in. drill in operation.

Rotary drills are in common use in the large open pit copper mines where steel bits give high drilling rates—three to six times that of churn drills—at low bit cost. In Minnesota iron mines, some ore can be successfully drilled with steel bits. But where interbedded semi-decomposed and hard taconite seams are common, carbide-studded bits are a must. Under these conditions, one company reports that its experiments with rotary and down-the-hole drills show quite comparable results in drilling speed and cost-per-ft. The 9½-in. rotary holes, however, place the 6-in. percussion holes at a disadvantage due to the greater volume of rock broken per ft of hole, but this may be eliminated if larger percussion drills are developed.

Hugh J. Leach, a graduate of the University of Minnesota School of Mines, and a native of Minnesota's Mesabi Range, has centered his interest on open-pit mining from early boyhood. His experience includes work as mining engineer with the Oliver Iron Mining Co., 1939 to 1941. Switching to the Evergreen Mines Co., he served as superintendent and district superintendent of mines from 1941 to 1945, when he joined the Cleveland-Cliffs



Iron Co. Leach was superintendent at Cleveland-Cliffs' Hill-Trumbull mine until 1953 when he advanced to his present position. Attainment of his place as an authority on open-pit mining and iron range operations is commendable, particularly since it was accomplished in conjunction with a fuller-than-normal personal life as an attentive head of a household with eight active children.

Kaiser Steel is experimenting with a down-the-hole machine for comparison with its rotaries. A Minnesota taconite mine still experimenting with 9-in. churn drilling reports improved results with new bit design and improved tempering. Although jet piercing is still the only answer in the hardest taconite, the heavy duty rotary, drilling 9½-in. holes, shows encouraging results in some pit areas where increased bit life was attained through improved bit design and drilling technique. A down-the-hole drill showed real promise in an experimental run and is thus very much in the taconite picture.

Another taconite operation reports that rotary drills compete with jet piercing in some ground, while a third states that because of uniformly hard rock, jet piercing is still the only answer to a very difficult drilling problem. A New York magnetite mine reports continued success with a down-the-hole drill in hard iron formation.

For secondary blasting and drilling smaller holes vertically, horizontally, or inclined, a fine selection of variously mounted drifter drills is available. Some are mounted on crawler or rubber-tired tractors with the tractor motor providing the compressor drive; others are mounted on air-powered tracks with wheel-mounted compressors as separate units. All provide mobility and versatility in situations where larger drills are unnecessary or impractical. Although no great interest has been indicated in horizontal rotary drilling, a large strip coal mine has produced a horizontal rotary drill weighing 55 tons and capable of drilling 50-ft holes.

Ammonium Nitrate Cuts Costs

One of the most outstanding developments in blasting procedure since black powder has been the application

of ammonium nitrate as a blasting agent. Starting in 1955 with akremit, development of methods for use of prilled ammonium nitrate has been continuous, and where ground conditions permit, its use has become almost universal.

Ammonium nitrate mixed generally with six to eight percent, by weight, of fuel oil has proved itself a safe, efficient blasting agent. It is adaptable in dry ground to any type of drill hole and to a wide variety of conditions. Where it can be used it provides substantial cost reduction in an important, and often expensive phase of open pit mining. Although mostly hand loaded in vertical holes, methods and machines have been devised for loading nitrate in vertical, horizontal, or inclined holes. Its effectiveness in hard rock is apparent in a Minnesota taconite pit where ammonium nitrate is loaded in 6½-in. jet pierced holes above a bottom charge of waterproof explosive to within four ft of the hole collar. A layer of lump ammonium nitrate is charged at water level to protect the prilled nitrate from water and three primers are used to attain maximum detonation speed. Excellent shattering is obtained which has substantially reduced secondary breaking. Also, because of the high percentage of undersize produced, greatly increased tonnage through the primary crushing plant is possible. A word of warning to those who would experiment with this high charge—concussion and fly rock prevent its use near other pit or plant installations.

Ammonium nitrate's one disadvantage is that it can't be used as a free-running blasting agent in wet holes. This has been overcome at some mines by packaging in various bags and tubes and in metal cans which are vibrated when filled to increase density. Several manufacturers are attempting to waterproof the prilled nitrate itself in order to eliminate packaging altogether. If packaging and waterproofing problems are surmounted, its general use in wet ground is certain since several methods have been devised for de-watering holes before loading by the use of small, high capacity, down-the-hole submersible pumps, thus clearing the hole for loading the low density nitrate.

Haulage

Although less spectacular, developments in haulage equipment continued and several interesting new units appeared in the field. The trend to larger rear-dump and trailer-type trucks, evident in past years, continued in 1957.

On the Mesabi range a new 400-hp, 35-ton, single rear axle truck was tested in several mines with results indicating possibilities for reduced

tire and fuel costs. Another manufacturer is finding good acceptance for its 40-ton tandem rear axle truck which replaces the 34-ton predecessor model. With overloading of the 34-ton truck a rather common abuse, this 40-ton model, available with single or twin engines, is designed to handle the overload situation with heavier frame, larger tires, and more horsepower. A third manufacturer offers a 40-ton, tandem rear axle truck featuring a 600-hp engine and new 9-speed transmission which will provide real competition. An interesting innovation has appeared in still another new 30-ton truck, test-run in 1956 and on the market in 1957. This truck is designed with no front axle, the wheels being supported by air cylinders, providing good underclearance and allowing an unusually short turning radius.

Trend to Larger Engines

Engine horsepower trend is upward in keeping with truck size and demand for higher performance. Torque converters are available for almost all trucks and easy-shift transmissions are common, although standard transmissions are still finding general usage. Horsepower increase in some instances has come through use of superchargers and turbochargers on standard engines which, in the case of one manufacturer's 12-cylinder unit, can raise horsepower from 400 to 600.

Tires Improved

Substantial improvement in tire life has come about through use of a heavier tire carcass of 28 to 32 plies combined with extra tread rubber. Originally designed to combat severe haulage conditions in Minnesota iron mines, use of these tires has spread to other mines. Now manufactured in 1600 and 1800 sizes, they provide approximately 50 percent more rubber above the plies for longer wear and in addition give greater protection to the carcass, thus reducing damage from deep cuts and breaks and allowing more recapping.

Experimental work continues with various applications of wire mesh protective plies between the tread rubber and carcass to provide protection for the fabric from rock penetration through the tread stock. Heat problems have developed, however, when they are used on long, high speed hauls. Use of tubeless tires increased in 1957 as they give promise of reducing tire troubles through elimination of tube and flap. An experimental tire which was inflated by inserting a needle through a rubber plug (as basketballs are inflated) attempted elimination of the expensive and sometimes troublesome valve stems. The experiment, although not



Rubber tired dozers are becoming increasingly popular. Unique feature of this model is that the frame is hinged in the center to provide a very short turning radius

immediately successful, indicates that tire companies are striving to reduce tire troubles to a minimum by eliminating components wherever possible.

Wider Use of Scrapers

Although still primarily a contractor's earth-moving tool, scrapers are being used in greater numbers by mine operators, particularly for stripping soft overburden. Pushloaded by large tractors, and preceded by rippers where necessary, these machines, in sizes up to 27 cu yd, continue to turn in excellent performance under conditions suited to their use. Lone Star Steel in Texas scrapes overburden from its shallow iron ore deposits, and Steep Rock in Canada uses them to remove previously broken ground where soft conditions require the maximum flotation provided by large scraper tires. Several uranium strip mines have employed them to advantage.

As scrapers have grown in size, pusher tractors have necessarily grown with them. In addition to the large crawler-type dozer-pusher units that have been in use for several years, a twin engine, rubber-tired pusher for scraper loading is now available that provides 420 hp to produce over 60,000 lb of drawbar pull.

Loaders

Interest in larger loading equipment was again evident in 1957. Several new 8-yd shovels were placed in operation on the Mesabi range, and a new open pit copper property

in Peru equipped its pit with ten of these large-size loaders. Wider use of alloy steels and electronic controls is evident. Wherever large tonnages are to be moved, shovel size will increase correspondingly with hauling units.

One manufacturer introduced a 6-yd diesel-powered shovel with equipment available for dragline conversion. This new machine is finding acceptance on jobs where large size and independence from electric power are desirable. The diesel motor can be replaced with electric drive if desired. The unit is equipped with a torque converter which it is claimed eliminates motor stalling and possible motor burnouts when electrically driven.

Conveyors and Skip Hoists

In truck haul pits where large tonnages justify the capital expenditure, conveyor and skip hoist installations for elevating the ore from pit bottom to surface continue to be popular because of proven low haulage cost and reliability. Interest in large capacity skip hoisting is increasing, possibly because of the advantage of eliminating pit crusher plant, ease of installation down steep pit slopes, and easy extension as the pit deepens. Four skip hoists are operating on the Mesabi; Steep Rock Iron Mines of Canada installed a skip hoist in 1957; Kennecott is installing a skip hoist at its Nevada Liberty pit which features 35-ton skips with three loading points; and Consolidated Copper Mines

is equipping its Tripp Mine with a system that will use 25-ton skips.

The trend toward the larger sizes is also displayed in such accessory equipment as tractors, both wheeled and track type, where weight and horsepower have been increased. Front-end loaders of diverse types and sizes are available for most tractor models. And here again, sizes have increased to the point where 4-yd buckets for loading ore and 6 to 8 yd buckets for lighter materials are available. An extra large grader is now in the market equipped with a 200-hp motor, torque converter, and easy-shift transmission. Rubber-tired dozers are becoming increasingly popular. Huge rippers for breaking tough ground ahead of scrapers are being tried experimentally in Minnesota to break top frost in surface stripping cuts. Results so far are encouraging.

Despite all this interest in large earth-moving machinery, manufacturers apparently are still finding demand for smaller units better suited to the many small open pits that could not be developed otherwise. Trucks and scrapers of 10 to 15-ton capacity are constantly being improved, and along with excellently designed 1/2 to 3-yd shovels, they provide the small mine with a wide choice of versatile mining tools.

It would seem appropriate at this point to scan the mining industry and point out the major new open pit projects and their significance. Other reviews in this issue, however, describe in considerable detail the majority of new mining projects—both open pit and underground—and readers are therefore referred to these articles under the various commodity titles. Of particular interest to open pit men are the accounts of new iron ore developments in R. C. Fish's "Iron Ore—Review and Outlook," and those on new copper mines in J. B. Pullen's "Copper." In addition, a number of new projects are described under other headings—Uranium, Industrial Minerals, Phosphate, Nickel, Potash and others.



A 4-cu yd shovel loads ore into a 40-ton, 500-hp truck at a Utah iron mine. Drill in background is a 40-R rotary



The taconite mines with their extremely tough, abrasive and sharp-edged rock provide the supreme equipment tests

By PHILLIP L. MERRITT
Senior Geologist, E. J. Longyear Co.

Uranium—The World Picture

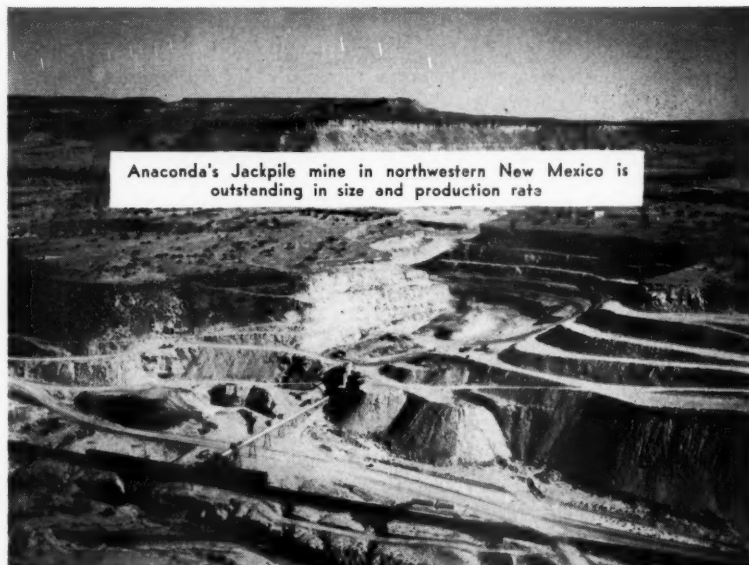
A DECADE ago, when Free World governments were faced with the need to increase the production of uranium for military purposes, the mining industry met the challenge. How well it did this can be gleaned from a look at the attainments of the industry. From a Free World production of over 13,000 tons in 1956, in 1957, the Free World production was in excess of 22,000 short tons of U_3O_8 in concentrates. Present plans indicate a continued expansion to more than 32,000 tons in 1958 and an annual rate exceeding 42,000 short tons during the 1959-1960 period. Both foreign and domestic production could be expanded further if required. The status of uranium mining as a major industry has been firmly established in three countries of the Free World—South Africa, Canada, and the United States. Production in other Free World countries, principally Australia, the Belgian Congo, France, Portugal, and the Federation of Rhodesia and Nyasaland, has not reached such a status.

Exploration Developments

Taken as a whole, in the Free World there was a marked decline in uranium exploration expenditures owing to the policy, on the part of the Atomic Energy Commission and the Combined Development Agency, of stabilizing financial commitments at the existing levels.

No new contracts have been made for South African and Australian uranium for several years. Indications are that no plans are under way to expand production in these areas, except in Australia where new plants are under construction in order to supply uranium to the United Kingdom. In Canada the deadline of new plant proposals was reached on March 31, 1956, hence, no new plants, except those now under construction, are planned. The French plan further expansion of production, and, consequently, exploration both by government and private capital is continuing. Little has been announced publicly on exploration activities in the Belgian Congo and Portugal. The United Kingdom is carrying out an extensive prospecting campaign in the Federation of Rhodesia and Nyasaland, and several Latin American countries have initiated exploration programs.

No new major districts were discovered in the United States during 1957 although important discoveries and extensions of reserves were made in the Grants district of New Mexico



Anaconda's Jackpile mine in northwestern New Mexico is outstanding in size and production rate

Uranium has attained major status in the mining industry, and new production records reached in 1957 will no doubt be exceeded in 1958 and 1959

and the Gas Hills and Shirley Basin districts of Wyoming. No physical exploration is being carried out by government agencies, and the attempt of the Atomic Energy Commission to limit domestic procurement commitments at approximately current levels caused a decline in privately financed domestic exploration. Although there was a decline in activity in New Mexico and Wyoming during the year, activity was still high at the year end.

In those portions of the Free World supported by procurement through the United States Atomic Energy Commission and the Combined Development Agency, most of the operating and planned plants have ample ore supplies to fulfill present contracts. Consequently, as a result of current procurement policies in the areas producing most of the Free World's uranium supplies, there has been a marked decline in exploration activities. On the other hand, in those coun-

tries where ore reserves are not large and production is at comparatively low levels, or non-existent, there has been a tendency for exploration to continue.

Metallurgical Developments

The acid leach - ion exchange process, using both column ion exchange and resin-in-pulp, has undergone no major change during the year and continues to account for about 70 percent of the Free World's production of uranium. New plants using column ion extraction were brought into operation both in the United States and Canada.

Acid leach - solvent extraction processes were installed late in 1956 in two plants, Climax Uranium Co. in Grand Junction, Colo., and Kerr McGee Oil Industries in Shiprock, New Mex. The solvent used is EHPA, di (2-ethyl hexyl) phosphoric acid dissolved in kerosene. Vitro Uranium Co. started

up a solvent extraction unit in its Salt Lake City plant in the latter half of 1957, using DDPA, mono (dodecyl) phosphoric acid. Texas-Zinc Minerals Company, in 1957, started the first plant based on aminetype solvent extraction.

The carbonate leach process has been the subject of intensive laboratory and pilot plant studies during the past year. As a result of studies at National Lead Company's Winchester Laboratory and Grand Junction pilot plant, and at the U. S. Bureau of Mines Intermountain Experiment Station, Salt Lake City, a better understanding of the function of aeration in uranium dissolution has been developed, permitting drastic reduction in leaching time and reduction in oxidant requirements.

Notice was given by the Atomic Energy Commission to National Lead Co. for the termination of the contracts for the operation of the pilot plant at Grand Junction, Colo., and the metallurgical research laboratory at Winchester, Mass. Presumably, the Commission feels that the operations in these installations will not be required in its modified procurement program. It is planned that any further work required along these lines will be carried out in private laboratories and the U. S. Bureau of Mines installation at Salt Lake City.

Australia

Production continued at both Rum Jungle, Northern Territory, and Radium Hill, South Australia. Construction of a new mill is under way at the Mary Kathleen deposit in Queensland. A new plant is planned at South Alligator River, Northern Territory.

At the Rum Jungle deposit a 225 tpd chemical plant is being operated by the Consolidated Zinc Corp. on behalf of the Australian Atomic Energy Commission. The mine, which is operated as an open cut, has a reserve of some 400,000 tons of ore having a grade of about 0.40 percent U_3O_8 . Production in 1957 was about 270 short tons of U_3O_8 .

In the underground mine at Radium Hill, South Australia, the uranium

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includes work abroad, as geologist in Northern Rhodesia with Selection Trust Ltd., of London, and as consultant with the Department of Mines in Bogota, Columbia. Returning to the United States in 1936, he was geologist for American Cyanamid Co. until 1942 when, as an officer in the U. S. Corps of Engineers, he was assigned to the Manhattan project, later receiving the Legion of Merit. After World War II, as a civilian, Phil continued his association with the Manhattan project as geologist until 1947. From 1947 to 1954 he was assistant director, Division of Raw Materials (Exploration) of the U. S. Atomic Energy Commission. As Senior Geologist with the E. J. Longyear Co. since 1954, he has remained in close touch with the uranium picture on a worldwide basis.

occurs in the uranium-titanium mineral, davidite. The ores are concentrated at Radium Hill, by heavy media flotation, and the concentrates are shipped to a 110-tpd chemical plant at Port Pirie. Both of these plants are being operated by the South Australian Department of Mines.

A 1120-tpd plant, with a mine, mill, and auxiliary facilities, is now under construction at the Mary Kathleen deposit near Mt. Isa, Queensland. The plant, which will be owned and operated by Rio Tinto Company, will draw its feed from a 3,400,000-ton uraniferous skarn deposit. The ore is said to average about 0.20 percent U_3O_8 .

Reserves developed so far in the South Alligator River area, Northern Territory, amount to 135,000 tons of ore, having a grade of about 0.47 percent U_3O_8 . United Uranium plans the construction of a 110-tpd chemical extraction plant for completion in 1959.

Plans are being formulated by Austand Uranium Mining Corp., Ltd., to exploit the Anderson Lode deposit, northern Queensland. This complex orebody has an estimated reserve of 280,000 tons averaging 0.20 percent U_3O_8 . Investigations are now under

way to extend the reserves and to solve metallurgical problems.

Although no official total for production from Australia has been announced, available information would indicate the 1957 production to be in the range of 450 to 500 tons of U_3O_8 . The ultimate production rate that will be attained during 1959, when presently planned plants are in operation, should be in the order of 1300 tons of U_3O_8 per year.

Belgian Congo

The Shinkolobwe Mine contributed in a major way to the success of the Manhattan Project and the development of the atomic bomb during World War II. Important quantities of uranium were shipped from stocks which had accumulated during the early mine operation from 1921 to 1936, and from the mine which was reopened in 1944. Mine production has been continuous since 1944.

Union Miniere de Haut Katanga, the owner of the Shinkolobwe Mine, has spent, over the years, some \$22,000,000 in the sinking of shafts and the development of the mine to a depth exceeding 800 ft. A treatment plant, costing about \$18,000,000 and having a capacity of 25,000 tons of ore per month was constructed during the post war years.

No official announcements have been made as to the reserves now known in the mine nor the rate of production. Announcements have been made to the effect that production has decreased since its post-war peak and is now exceeded by the production of Canada, the Union of South Africa, and the United States.

Canada

By the end of 1957, 13 plants were in operation in Canada, with six more scheduled for completion by mid-1958. Production rose from about 2300 tons of U_3O_8 in 1956 to about 6700 tons in 1957, and it should rise to an annual rate of 15,000 tons of U_3O_8 during 1958.

In the Northwest Territory, production continued at the Port Radium Mine and was initiated during the year at the Rayrock Mine. The most important production in Canada, however, is derived from the ores of the Lake Athabasca district in northern Saskatchewan, near Bancroft in eastern Ontario, and the Blind River district in south central Ontario. In Saskatchewan one new plant, at Lorrain, came into production bringing a total of three new plants in operation, with a total annual milling capacity of about 1,600,000 tons. In the Bancroft area, the Faraday and Bancroft plants came into operation during the year, and with one more plant under construction, an annual installed capacity of approximately 1,200,000 tons of ore is anticipated by mid-1958. One of the great mining

TABLE 1—URANIUM PLANTS IN OPERATION UNDER CONSTRUCTION AND PLANNED IN AUSTRALIA

Company or Government Agency and Location	Initial Uranium Production	Plant Capacity Short Tons Per Day	Estimated Capital Cost of Plant & Mine Installation
Australian Atomic Energy Commission Rum Jungle, Northern Territory	1954	225	\$11,000,000
South Australian Department of Mines Radium Hill, South Australia	1955	110*	15,500,000
Rio Tinto Company Mary Kathleen, Queensland	1959	1,120	22,000,000
United Uranium N.L. South Alligator River, Northern Territory	1959	110	2,200,000
		1,565	\$50,700,000

* Chemical treatment plant capacity. Capacity of heavy media and flotation plant not announced.

camps of the world is under development in the Blind River area where two plants were in operation in 1956, four came into operation during 1957, and five are under construction. By mid-1958 there should be 11 operating plants, having a yearly capacity of about 12,500,000 tons of ore.

In all producing areas of Canada, developed reserves are generally more than adequate to cover current contracts and in some areas sufficient for a score or more of years. For instance, in Blind River production is supported with a drilled-out and potential reserve exceeding 320,000,000 tons of ore averaging about two pounds of U_3O_8 per ton, and reserves are ample in other areas to support current production contracts.

The Canadian new mill construction and mine development programs are somewhat behind those originally scheduled in almost all projects, with capital overrun being the general rule. However, when full production is realized during 1957, uranium could well be first in dollar volume in the Canadian mining industry, with an annual revenue exceeding \$300,000,000. When completed this program will have required in excess of \$400,000,000 in capital expenditures for plants and mine development. Contracts now in force have a total value of about 1.6 billion dollars.

France

The uranium exploration program in metropolitan France, carried out by the Commissariat a l'Energie Atomique since 1945, has enabled France to become the leading producer of uranium from western Europe. Although all prospecting, until recently, has been carried out by the Commissariat, attempts are now being made to encourage private participation. It has been reported that private capital has spent about \$2,500,000 in exploration during the past year and a half and that important finds have been made.

Prospecting, both by air and ground methods, has extended to various parts of the French Union including French West Africa, French Equatorial Africa, Madagascar, and French Guiana. Also, Algeria and the former French protectorate of Morocco have been examined. Although many uranium occurrences have been located, those of most significance, in the French Union, are in Madagascar and French Equatorial Africa. In this latter area a promis-

TABLE 3—IMPORTANT URANIUM DEPOSITS IN METROPOLITAN FRANCE

District	Province	Deposit
Vendee	Loire-Atlantique	l'Ecarpiere
	Deux-Sevres	La Chapelle-Largeau
	Deux-Sevres	La Commanderie
Limousin	Haute-Vienne	Brugaud
	Haute-Vienne	Fanay-Les Sagnes
	Haute-Vienne	Margnac
Forez	Loire	Bois Noirs

TABLE 2—URANIUM PLANTS IN OPERATION AND UNDER CONSTRUCTION IN CANADA

Company & Location	Initial Uranium Production	Plant Capacity Short Tons Per Day	Estimated Amount of Current Contract
I. Plants in Operation prior to 1958.			
Northwest Territory			
Eldorado Mining & Refining Ltd.	1942*	300	\$33,500,000
Rayrock Mines Ltd.	1957	150	15,792,000
Lake Athabasca District, Saskatchewan			
Eldorado Mining & Refining Ltd.	1953	2,000	168,500,000
Gunnar Mines Ltd.	1955	1,650	76,950,000
Lorado Uranium Mines Ltd.	1957	750	64,380,000
Blind River District, Ontario			
Algoma Uranium Mines Ltd.			206,910,000
Quirke Property	1956	3,000	
Nordic Lake Property	1957	3,000	
Can-Met Explorations Ltd.	1957	2,500	75,852,000
Consolidated Denison Uranium Mines Ltd.	1957	6,000	201,850,000
Northspan Uranium Mines Ltd.			275,000,000
Nordic Lake Property	1957	4,000	
Pronto Uranium Mines Ltd.	1955	1,500	55,000,000
Bancroft District, Ontario			
Bicroft Uranium Mines Ltd.	1957	1,000	35,805,000
Faraday Uranium Mines Ltd.	1957	1,250	45,000,000
Sub-Total		27,100	\$1,254,539,000
II. Plants scheduled for completion during 1958.			
Blind River District, Ontario			
Milliken Lake Uranium Mines Ltd.		3,000	94,525,000
Northspan Uranium Mines Ltd.			(See Northspan Above)
Panel Property		3,000	
Spanish Property		2,000	
Stanleigh Uranium Mines Ltd.		3,000	90,396,000
Stanrock Uranium Mining Corp.		3,000	95,177,000
Bancroft District, Ontario			
Canadian Dyno Uranium Mines Ltd.		1,000	34,810,000
Sub-Total		15,000	\$314,908,000
TOTAL		42,100	\$1,569,447,000

* Initial operation in 1930's.

ing new discovery was made in 1957, the Mounana deposit, near Franceville, in the Gabon.

In metropolitan France seven deposits in three districts are in operation or are expected to come into operation during the next two years. The reserves of these seven deposits, developed by drilling and mining, amount to about 20,000 short tons of U_3O_8 in ores with an average grade of 0.12 percent to 0.24 percent U_3O_8 . The reserves of metropolitan France, yet to be completely proven, have been estimated at from 65,000 to 130,000 short tons of U_3O_8 . About 10 other prospects in these areas are also under extensive investigation. All of these deposits occur in Hercynian in-

trusive rocks and are generally closely related to faults and fractures.

During 1957 two chemical leach plants were in operation: One at Gueugnon, Saone-et-Loire, has a nominal capacity of 36,000 short tons of ore per year and another at l'Ecarpiere, Loire-Atlantique has an annual capacity of 165,000 short tons of ore. With the expansion programs under way at this latter plant and a new plant at Bessines, Haute-Vienne, planned for production in 1958, the French annual leach capacity will be raised from the year-end capacity of 201,000 short tons to 586,000 tons by the end of 1958. Plans are under way to expand the Bessines plant to 660,000 tons and to construct a new plant

TABLE 4—URANIUM PLANTS IN OPERATION OR PLANNED IN FRANCE

Operating Plants	Location	Initial Uranium Production	Annual Capacity Short Tons of Ore
Gueugnon	Saone-et-Loire		36,000
l'Ecarpiere	Loire-Atlantique ..	1957	165,000*
New Plants			
Bessines	Haute-Vienne	1958	220,000**
St. Priest			
La Prugne	Loire	1960	220,000

* Expansion to 330,000 short tons of ore per year to be completed by the last half of 1958.

** Planned expansion to 660,000 short tons by 1960.

at St. Priest La Prugne with an annual capacity of 220,000 tons of ore. This latter plant is scheduled for completion by 1960.

In 1957 production will be about 500 short tons of U_3O_8 including 65 short tons from Madagascar. With a prospective annual capacity of 1,246,000 short tons of ore, the objective of the expansion program is to raise the annual production to about 2000 short tons of U_3O_8 by the early 1960's.

Portugal

A British-owned company, Companhia Portuguesa de Radium Ltda., currently is operating uranium mines

in north central Portugal and a leach plant at Urgeirica. No announcements have been made on reserves, size of operating plant, or rates of production.

Federation of Rhodesia and Nyasaland

A small chemical treatment plant at the Nkana mine, Northern Rhodesia, started production during 1957. The output of the plant is being purchased by the United Kingdom Atomic Energy Authority.

Union of South Africa

The uranium industry in the Union of South Africa is based on produc-

tion from tailings of the gold industry of the Transvaal and Orange Free State. In some of the reefs the gold values are insufficient to mine for gold alone, and hence the advent of the uranium program has increased considerably the amount of pay ore and lengthened the life of some mines. The only new plant to come into operation during 1957 was that at Buffelsfontein. Thus, from the initial plant which went on stream five years ago, the industry has grown until today 26 mines are contributing feed to 17 plants. A total capital expenditure of nearly \$200,000,000 has been made in the industry.

Production rose in 1957 to approximately 5700 tons of U_3O_8 from 4250 tons in 1956; it should be about 6000 tons in 1958. Each mill is under contract for a period of 10 years from the time of full production, but none extend beyond December 31, 1966. The uranium feed to the plants ranges from about 0.20 pounds to 1.40 pounds of U_3O_8 per ton. South African uranium reserves have been estimated officially at more than 1 billion tons of ore containing some 370,000 tons of U_3O_8 —sufficient to sustain production at the projected rate for several decades.

The annual revenue will, in 1958, be approximately \$130,000,000, and, during the contract operating period, the gross revenue should approximate one billion dollars. Thus, uranium has become second only to gold as a foreign exchange producer in the economy of the Union of South Africa. The importance of this infant industry in the South African mining economy is emphasized by a recent estimate to the effect that approximately one-third of the 1956 profits of the gold mining industry, taken as a whole, was derived from uranium production—\$134,000,000 for gold and \$67,000,000 for uranium. During the second quarter of 1957, the 23 mines in the uranium program for which profit figures were available, showed uranium profits of about \$20,700,000 and gold profits of about \$23,000,000.

United States

In the United States 1957 was marked with the completion of five new plants, adding a daily plant capacity of 2875 tons. This brought the total daily capacity to about 11,800 tons of ore in 16 operating plants. With the seven new plants scheduled for completion during 1958 and early 1959, the daily capacity will rise to nearly 21,000 tons of ore. Under the Commission's policy of holding production to the approximate level to be reached as a result of existing commitments, expansion will be curtailed to providing limited markets in those areas having no present milling facilities.

Since the declassification of domestic production information, U_3O_8 in

TABLE 5—URANIUM PLANTS IN OPERATION IN THE UNION OF SOUTH AFRICA

Mining Companies Approved for Production	Location	Initial Uranium Production	Plant Capacity Short Tons Per Month	Pounds of U_3O_8 Per Short Tons Treated
West Rand Cons. Mines, Ltd.	West Rand Cons.	Oct. 1952	70,000	1.405**
Daggafontein Mines, Ltd.	Daggafontein	Apr. 1953	120,000	0.463**
Blyvooruitzicht G. M. Co. Ltd.	Blyvooruitzicht	Apr. 1953	160,000	0.328**
Western Reefs Expl. & Dev. Co. Ltd.	Western Reefs	Sept. 1953	200,000	0.247**
Stilfontein Ellaton	Stilfontein	Sept. 1953	180,000	0.283**
Afrikander Lease				0.317**
New Klerksdorp				0.348***
Babroscro				0.797***
Randfontein Estates G. M. Co. W. Ltd.	Randfontein	Feb. 1954	150,000	0.913**
East Champ d'Or G. M. Co. Ltd.				0.847**
Luipaards Vlei Estate & G. M. Co. Ltd.	Luipaards Vlei	Nov. 1954	50,000	1.311**
Vogelstruisbult G. M. Areas Ltd.	Vogelstruisbult	Dec. 1954	40,000	0.451**
Pres. Steyn G. M. Co. Ltd.	President Steyn	Jan. 1955	150,000	0.355***
Pres. Brand G. M. Co. Ltd.				0.346***
Free State Geduld* Mines, Ltd.				
Western Holdings* Ltd.				
Welkom G. M. Co. Ltd.	Welkom	Jan. 1955	150,000	0.273***
Freddies Cons.				0.380***
Lorraine Gold Mines Ltd.				0.215***
Harmony G. M. Co. Ltd.	Harmony	Mar. 1955	80,000	0.479**
Dominion Reefs (Klerksdorp) Ltd.	Dominion Reefs	June 1955	40,000	0.933**
Virginia O.F.S. G. M. Co. Ltd.	Virginia	Sept. 1955	130,000	0.503*
Merriespruit (O.F.S.)* G. M. Co. Ltd.				
Vaal Reefs Expl. & Mining Co. Ltd.	Vaal Reefs	May 1956	65,000	0.708**
West Driefontein G. M. Co. Ltd.	West Driefontein	Sept. 1956	80,000	0.272**
Doornfontein G. M. Co. Ltd.				0.238**
Hartebeestfontein G. M. Co. Ltd.	Hartebeestfontein	Oct. 1956	100,000	0.785**
Buffelsfontein G. M. Co. Ltd.	Buffelsfontein	July 1957	100,000	****
Total Tons Per Month			1,865,000	

* Not contributing feed to uranium plants.

** Averages—second quarter, 1957.

*** Reported average grade.

**** Information not available.

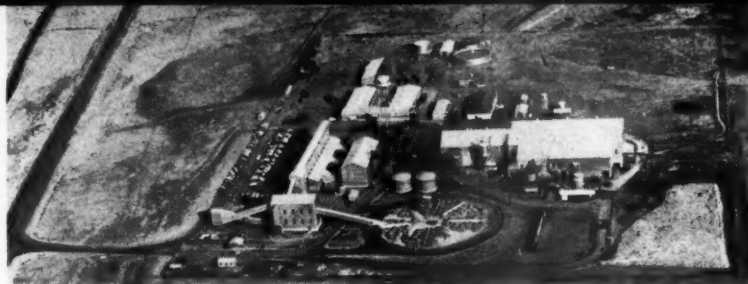
concentrates has been produced as follows:

Six-Month Period	Production U ₃ O ₈ in Concentrates (Short Tons)
July 1, 1955-December 31, 1955	1,600
January 1, 1956-June 30, 1956	2,600
July 1, 1956-December 31, 1956	3,376
January 1, 1957-July 1, 1957	4,141

With the major increase in mill capacity during the latter part of 1957, domestic production rose from approximately 6000 tons in 1956 to about 8500 tons during 1957, and during 1958 it could exceed 13,000 tons. The magnitude of production during 1958 depends largely upon the completion dates of the large new projects now under way in the Ambrosia Lake area of New Mexico. A production rate of some 18,000 tons of U₃O₈ should be reached during 1959, when all plants now operating or under construction should be in full production. This industry will have over \$135,000,000 invested in plant, and the product should have an annual value exceeding \$300,000,000. Thus, uranium should be among the top three in value in our domestic metal mining industry.

The industry is supported by an ore reserve, calculated by the Atomic Energy Commission, as of October 1, 1957, of 73,800,000 tons of measured, indicated and inferred ore, which the Commission considers "economically mineable and metallurgically amenable to treatment." Perhaps 25 percent of this reserve is in the inferred category. This ore contains approximately 200,000 tons of U₃O₈. Of these ore reserves approximately 70 percent are in New Mexico, 16 percent in the states of Colorado, Utah, Arizona, and 10 percent in Wyoming.

In the year intervening between the last two Commission ore reserve estimates, the reserves increased nearly 14,000,000 tons, with the major increases being in the Ambrosia Lake



The new mill of Uranium Reduction Co., the first independent uranium mill in the United States, was financed through conventional institutional and equity channels

TABLE 6—URANIUM PLANTS IN OPERATION OR PLANNED IN THE UNITED STATES

Company and Location	Initial* Uranium Production	Plant Capacity Short Tons Per Day	Estimated Capital Cost of Plant
I. Plants in operation prior to 1958			
Atomic Energy Commission, Monticello, Utah	1949	600	\$ 5,000,000
Climax Uranium Company, Grand Junction, Colo.	1951	350	3,088,000
Dawn Mining Company, Ford, Wash.	1957	400	3,100,000
Kerr McGee Oil Industries, Shiprock, N. Mex.	1955	500	3,161,000
Mines Development, Inc., Edgemont, S. Dak.	1956	300	1,900,000
Rare Metals Corporation, Tuba City, Ariz.	1956	250	3,600,000
Texas Zinc Minerals Co., Mexican Hat, Utah	1957	775	7,000,000
The Anaconda Company, Bluewater, N. Mex.	1953	3,000	19,358,000
Union Carbide Nuclear Co., Uravan, Colo.	1950	1,100	5,000,000
Union Carbide Nuclear Co., Maybell, Colo.	1957	300	2,208,000
Union Carbide Nuclear Co., Rifle, Colo.**	1957	1,000	8,500,000
Uranium Reduction Co., Moab, Utah	1956	1,500	8,250,000
Vanadian Corp. of America, Durango, Colo.	1949	430	813,000
Vanadian Corp. of America, Naturita, Colo.	1947	350	1,000,000
Vitro Uranium Company, Salt Lake City, Utah	1951	550	5,500,000
Western Nuclear Corp., Split Rock, Wyo.	1957	400	3,600,000
Sub-Total		11,805	\$81,078,000
II. Plants scheduled for completion in 1958 and 1959.			
Fremont Uranium Company, Riverton, Wyo.		500	\$ 3,500,000
Gunnison Mining Company, Gunnison, Colo.		200	2,025,000
Homestake-New Mexico Partners, Grants, N. Mex.		750	5,325,000
Homestake-Sapin Partners, Grants, N. Mex.		1,500	9,000,000
Kermac Nuclear Fuels Corp., Grants, N. Mex.		3,300	16,000,000
Lakeview Mining Company, Lakeview, Oreg.		210	2,600,000
Lucky Mc Uranium Corporation, Fremont County, Wyo.		750	6,900,000
Phillips Petroleum Co., Grants, N. Mex.		1,725	9,500,000
Sub-Total		8,935	54,850,000
TOTAL		20,740	\$135,928,000

* Since World War II.

** Replaces previous plant and includes two upgrading plants.

TABLE 7—URANIUM ORE RESERVES IN THE UNITED STATES MEASURED, INDICATED AND INFERRED ORE (From the Atomic Energy Commission)

	November 1, 1956			October 1, 1957		
	Ore Short Tons	Ore Grade % U ₃ O ₈	Short Tons of U ₃ O ₈	Ore Short Tons	Ore Grade % U ₃ O ₈	Short Tons of U ₃ O ₈
New Mexico	41,000,000	0.24	98,400	51,400,000	0.26	133,640
Wyoming	2,300,000	0.22	5,060	7,600,000	0.26	19,760
Utah	7,500,000	0.34	25,500	6,000,000	0.37	22,200
Colorado	4,100,000	0.33	13,530	4,200,000	0.30	12,600
Arizona	2,600,000	0.30	7,800	1,600,000	0.30	4,800
Washington	1,500,000	0.18	2,700			
Washington, Oregon, Nevada				1,700,000	0.23	3,910
Others*	1,000,000	0.24	2,400			
Others†				1,300,000	0.25	3,250
	60,000,000	0.26	153,390	73,800,000	0.27	200,160

* California, Idaho, Montana, Nevada, North Dakota, Oregon, South Dakota, Texas.

† Alaska, California, Idaho, Montana, South Dakota, Texas.

area of New Mexico and the Gas Hills area of Wyoming, where exploration has been particularly successful in bringing in new discoveries and ore extensions. In the most striking changes in reserves during the year, the combined totals of New Mexico and Wyoming showed an increase of 15,700,000 tons of ore and those of Colorado, Utah, and Arizona showed a decrease of 2,400,000 tons of ore.

The uranium mining industry, as a whole, has less than a ten-year ore supply at the projected 1959 rate of operation of approximately 7,500,000 tons of ore per year. With no major discoveries in Utah, Colorado, and Arizona during the past few years, the plants depending on ore from these areas could be severely limited in life unless the rate of exploration and ore discovery picks up. Present indications are that much of the easy ore, particularly on the Colorado plateau, has been found, and more costly exploration, involving deeper drilling for hidden orebodies, will be required in the future. Thus, the risk factor, barring fortuitous discoveries, will no doubt increase. On the other hand, as information on the geological occurrence of uranium increases, and technological developments in exploration methods advance, the anticipated higher cost of ore discovery may be offset to some extent. However, in New Mexico, particularly in the Grants area, and in Wyoming, particularly in the Gas Hills area, where reserves are continuing to expand, the outlook is favorable for a continued long life of the industry.

Outlook

With several new plants coming into operation during 1958 and 1959 in Australia, Canada, France, and the United States, the peak of Free World uranium production has yet to be reached. From a Free World production in 1957 in excess of 22,000 short tons of U_3O_8 , production should rise to over 32,000 tons in 1958, and in the 1959-1960 period to more than 42,000 short tons. At that time the purchase cost to the United States and the United Kingdom should exceed the annual rate of \$800,000,000.

The United States Atomic Energy Commission is by far the largest buyer of the Free World's uranium supplies, probably purchasing over 80 percent of the production excluding that in France. The United Kingdom has participated with the United States Atomic Energy Commission in some of its foreign purchases through the Combined Development Agency and has, through the United Kingdom Atomic Energy Authority, made independent contracts in Australia, Canada, and the Federation of Rhodesia and Nyasaland. Although changes made in the Atomic Energy Commission's procurement policy reflected the

TABLE 8--FREE WORLD URANIUM PRODUCTION*
(Short Tons of U_3O_8)

	Approximate 1957	Estimated for 1959-1960 Period
Australia	450	1,300
Canada	6,700	15,000
France	500	2,000
Union of South Africa	5,700	6,000
United States	8,500	18,000
	21,850	42,300

* Excludes the Belgian Congo and Portugal.

great increase in production from the purchase commitments during the past few years, production should rise in the next two to three years to the planned goals of the 1959-1960 period.

During 1957, the Free World's uranium production was carried out in 53 plants, 16 of which came into operation during the year. Present plans indicate that another 18 plants should be completed during the next two years. With most of these operations protected by long-term government contracts terminating between 1962 and 1967, and with amortized plants upon the completion of the contracts, the established uranium milling industry can look forward with confidence during the next few years. In most foreign areas where production is high, reserves are generally more than adequate to fulfill current contracts and, consequently, no large-scale exploration is in progress or planned. In contrast to the generally adequate long-range reserves in the most important areas abroad, our now known reserves are inadequate to take care of post-1966 production at the contemplated 1959 rate.

The Commission's present procurement policy was spelled out by Jesse C. Johnson, the Director of the Raw Materials Division, in an October speech in New York before the Atomic Industrial Forum. He said in part,

"Uranium deliveries under the Commission's present domestic and foreign commitments appear adequate for military and power requirements as projected on an annual basis for the next few years. Furthermore, we are in the fortunate position of being able to expand substantially domestic production in case of a sudden increase in requirements. Canadian production also could be expanded . . .

"The objective should be to have a strong uranium industry, with substantial ore reserves, capable of expanding to meet the requirements for atomic power as these requirements develop.

"Under these circumstances the Commission, at this time, is faced with limiting commitments for additional domestic uranium production . . .

"With respect to new proposals between now and 1962 for additional

mill construction or mill expansion, the objective of the Commission will be to limit production to the approximate level which will be reached as a result of existing commitments. . . .

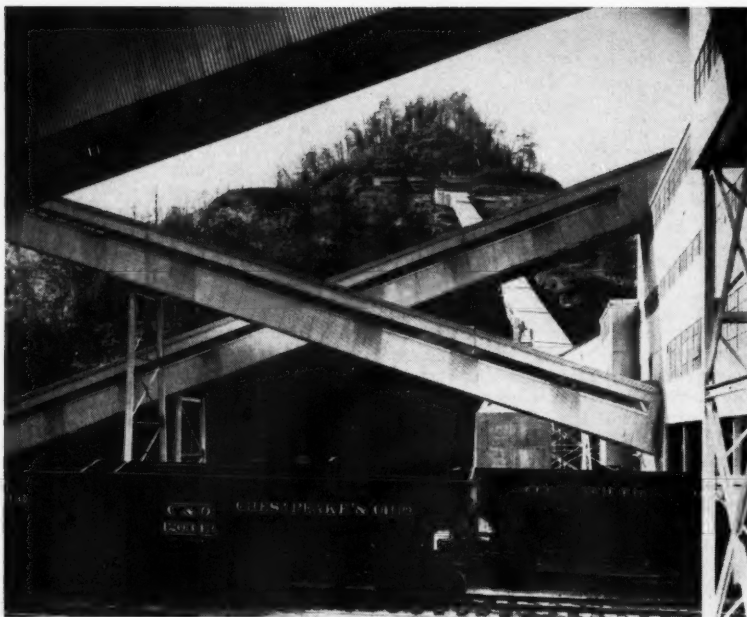
"As for foreign purchases, no new commitments have been made for several years. On the contrary, foreign commitments have been reduced by releasing to the United Kingdom material which was under firm contract to us.

"This reference to the current problem should not create the impression that we have too much uranium. The immediate objective is to keep production and requirements in reasonable balance, but the long-range problem is to develop additional ore reserves for our future requirements. We cannot deplete existing reserves and expect to meet future military and industrial needs as they arise."

The growth of the nuclear power industry is dependent, in many parts of the world, upon a reduction in power costs from those being attained in operating plants. The realization by the industry that the short-term uranium requirements for power will probably be small when compared to the production capabilities of the industry and the fear of the possible effects of fusion on the long-term growth of the nuclear power industry, coupled with the uncertainties in the Atomic Energy Commission's purchase policy upon the expiration of present contracts in the 1960's, has created pessimism in the uranium industry.

On the optimistic side, industry can look to the long-range plans for both stationary and propulsion plants both here and abroad, and can see a constantly rising trend in requirements. These have been estimated in the range of 50,000 to 100,000 tons of uranium by 1975. Engineers are optimistic that material reduction in nuclear power costs can be attained during the next five to ten years—enough to bring costs into a competitive range with conventional power in many parts of the world. As for the effects of fusion on the long-range growth of the nuclear power industry, the Atomic Energy Commission stated, "The realization of the production of thermonuclear neutrons (fusion), if

(Continued on page 92)



The future is expected to see fewer, but larger, more efficient coal preparation plants built

Coal Preparation

Cleaning plants grow more complex as need for quality control increases. There is a definite trend towards automation

By R. E. JOSLIN

Manager, Coal Preparation
Clinchfield Coal Division
The Pittston Co.

COAL production for the year started off well; but in the last half of 1957 production dropped off, ending the year about 10 million tons less than in 1956. This breathing spell gave all concerned, especially preparation men, an opportunity to study more closely their present and future problems. Everyone concerned will have to work a little harder and longer to lower mine costs and preparation plant costs, and strive to reach the ultimate in quality, recovery, and overall reduction of costs.

Quality Important

Quality control, tailoring the product to suit the individual plant and customer, came in for a fresh look during the year. Sampling and analyses' costs have been on the increase for years, as coal producers struggle to keep the customer satisfied. There-

fore, machine sampling was stressed during the year. As preparation plants grow larger and fewer, mechanized sampling becomes very important. Automatic or mechanized sampling is a tool which can be used to reduce costs, eliminate the ever present human error, insure the plant operator and customer a better analysis of product and improve plant efficiency. At Clinchfield Coal's new Moss #3 plant, now under construction, all products will be sampled mechanically and automatically. Hand riffing of the samples will be reduced to a minimum. Discrepancies in analyses, which are caused mainly by the sampling technique, are the cause for much customer dissatisfaction. Mechanical sampling should do much to reduce this to a minimum. Some research work now going on may, in the near future, eliminate both the sampler and analyst, especially for moisture, ash, and sulphur.

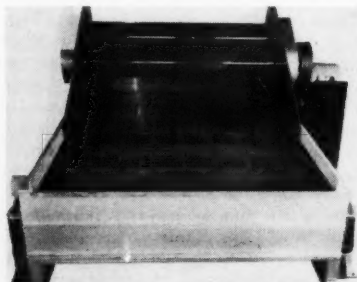
Screening

Screens for screening of coal have always been the most important piece of equipment in the plant. At one time Parish type shaker screens were, for all practical purposes, the preparation plant. Today, screens of all kinds and descriptions are used; and each has its place in the plant circuit. The year saw eight ft wide by 16 ft and 20 ft long vibrator screens introduced. Two manufacturers are producing these large screens which

will be used for screening ahead of the various cleaning units, especially in the larger plants where space requirements have to be held to a minimum. Moss #3, scheduled for completion in the latter part of 1958, will use 16 of these 8 by 16-ft screens. Eight will be for initial raw coal screening at $\frac{3}{4}$ in., and eight will be used for drain and rinse of magnetite behind the heavy density units.

Coarse Coal Washing

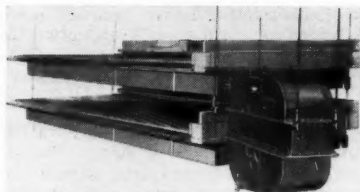
One Heavy-Media washer using sand was introduced during the year. This unit uses sand as the medium and is patterned after the wheel type magnetite vessels. This vessel is the first new development in sand washers since the Chance Cone was introduced about 1920. The main advantage of this new unit, as compared to



Larger screens were introduced in 1957



Dick Joslin entered the coal industry in 1929 with the Rochester & Pittsburgh Coal Mining Co. in the Engineering Department. He later organized R & P's Preparation Department. From 1947 until 1956 he was with Pittsburgh Consolidation Coal Co., spending most of the time with Fairmont Machinery Co. in the Sales and Service Department. He joined Clinchfield Coal Co. in 1956 as manager of its Preparation Department.



With the introduction of the twin-deck suspended table, coal preparation plant designers will have greater flexibility in plant layout

a Chance Cone, is that less height is required since the gates have been eliminated and refuse is discharged at the same elevation as the coal. Two plants in Northern West Virginia have installed this heavy media sand washer. Connected horsepower is reported to be about half for the same feed tonnage as to a Chance Cone.

Magnetite washers were being installed in greater numbers, as lower gravity and higher efficiency of cleaning is required. No major improvements or new magnetite washers were introduced during the year. Manufacturers of this equipment concentrated their efforts on improving the efficiency of present equipment. Recovery of magnetite was stressed as most important, and manufacturers of magnetite recovery equipment were active in improving magnets and related equipment for recovery of magnetite.

Fine Coal Cleaning

The introduction of the Double Deck #77 tables was one of the outstanding advances in coal preparation in recent years. The twin deck table doubles feed capacity per unit of floor space as compared to the single deck table. Impact to the supporting structure is eliminated with the new fully integrated head motion, the whole unit being suspended by wire cables for full floating operation. With this new unit, launders, piping, wiring, and connected horsepower are reduced by half. As near as can be deter-

mined, capacity and cleaning efficiency is the same as for the single deck table. Our plant going into operation in the summer of 1958 will have 32 units, the equivalent of 64 single decks.

Since initial installation cost on a per ton hour capacity basis is reduced by more than half, it is apparent that table plant installations should be greatly accelerated in the near future.

Dewatering

Since the initial cost of heat drying is based on the amount of water to be evaporated, mechanical removal of water ahead of heat drying becomes most important.

Dewatering of fine coal, namely the minus $\frac{3}{8}$ in., ahead of the heat dryers becomes increasingly important as more mechanical mining is used. Mechanical mining produces more fines; then too, wet washing of the minus $\frac{3}{8}$ -in. fraction is increasing at an accelerated rate. Plants which a few years ago put in coarse coal cleaning and continued to load the minus $\frac{3}{8}$ raw have added, or have on the drawing boards, plans to wet wash the fine sizes.

For mechanical dewatering the engineer has a variety of equipment to pick from. When it comes to final decision, it depends upon tons per hour, plant feed, the tons per hour to be mechanically dried, the water circuit used, and the type of silt disposal—ponds versus filters.

Two Humboldt dryers were put in service in a plant in Northern West Virginia during the year. These proved successful down to minus 28 Mesh, with the minus 28 Mesh being removed ahead of the unit. It will take longer operating time and experience to establish maintenance figures on these machines.

Dust Collection

Dust collection on dryer stacks was much in evidence during the year.



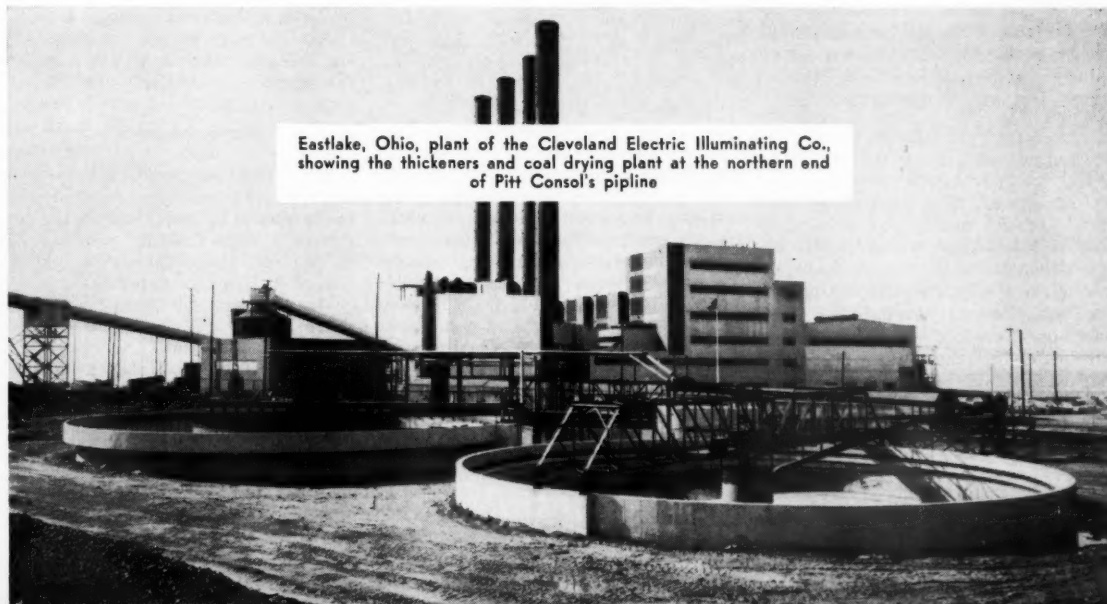
Units such as this one, which measures specific gravities automatically, moved the industry a step closer to full automatic control of coal preparation plants

Pocahontas Fuel Co. installed wet scrubbers at their Bishop Plant and, from reports, they are successful. Most new plants under construction or on the drawing boards are incorporating wet scrubbers on the drying stacks.

Joy Manufacturing Co., after several years' experimentation, introduced their Microdyne Wet Scrubber for installation on heat dryer discharge stacks. Advantages for this scrubber are less space required, and less weight per volume of gas. Efficiencies are about the same as other efficient wet scrubbers.

Water Clarification

Clarification of the waste water (black water) from the plants is still a prime problem and water clarification came in for considerable discussion during the year. Operators get squeezed from the stream pollution on one side and cost of clarification on the other. Where terrain permits, a settling pond is the easy way out; and for years, many operators have resorted to this method. In mountainous areas, such as Southwest Virginia and the Southern part of West Virginia, however, the cost of build-



Eastlake, Ohio, plant of the Cleveland Electric Illuminating Co., showing the thickeners and coal drying plant at the northern end of Pitt Consol's pipeline

ing silt dams becomes prohibitive. At one plant the cost of building such a dam was approximately \$200,000 and it was filled up in a year's time. In view of these costs, filtering and recovering the solids for steam products is economical. Several plants have installed filters for this purpose, and others have plans on the drawing board.

Automation

Automatic controls and recording instruments continued to be used in greater numbers during the year 1957. The Industrial Nucleonics Corp. introduced their Accu-Ray measuring instrument. This measuring instrument has possibilities of many uses in the preparation plant.

This instrument was installed on the heavy media vessel at one preparation plant to record specific gravity in the vessel to give the operator an accurate recorded picture of the gravity in the vessel at all times and do away with constant hand-checking with a volumetric balance. Thus a cleaner product is insured, with less coal lost to the refuse disposal.

Another Accu-Ray instrument was installed in the filter feed line. For maximum efficiency a filter should be fed at a constant rate of solids content. When this instrument was installed, it was surprising to find such a large variation in solids in the filter feed.

With instruments such as these it is an easy step to full automatic con-

trol, insuring a better product, more efficient operation, and reduction in overall costs.

Conclusion

Contributors to coal preparation progress in 1957 were many. Proper credit and appreciation should be given to all who have contributed in any way to the improvements and advantages which are available to us today.

In the future it is expected to see fewer preparation plants built; those that are will be much larger, more efficient and practically automatic.

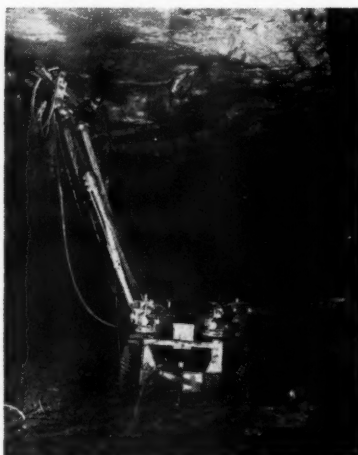
The foregoing observations of coal preparation in 1957 are the author's views as seen in his scope of preparation activities.

LEAD AND ZINC

(Continued from page 80)

legislation, he had been assured the industry would again petition the Tariff Commission for "Escape Clause" action and that the President would ask the Commission to expedite the proceedings. It is noteworthy to remember that in 1953 the industry had petitioned the Commission and received a unanimous recommendation for increased duties. In lieu of accepting these recommendations in August 1954, the President increased defense stock pile purchase and initiated the barter program.

Thus the hearings before the Commission in late November, following the Senate and House hearings during the summer, became the third public forum in one year as domestic producers sought to correct their acute problem. Under existing law the maximum permissible increase in tariff which the commission can recommend is from the present 0.7 cents to 2.1 cents for slab zinc and from the present 1-1/16 cents to 2.55 cents for pig lead; or about a 1½ cents increase above the present tariff for each metal. Since this maximum increase is inadequate, the domestic producers also petitioned the Commission for import quotas and sub-



Because of adverse economic conditions, U. S. operators were forced to curtail exploration and development programs

mitted a quota plan for the Commission's consideration.

The year closed with U. S. prices of 13 cents for lead and 10 cents for zinc, a decline of 19 percent and 26 percent respectively, and with the London market at about 9 cents for lead and 8 cents for zinc. This excessive differential between U. S. prices and London prices, particularly for lead, gave rise to doubts as to

whether the U. S. price had yet reached its lowest level in the present price decline period. Also, due to the pricing policy of certain foreign importers, late in the year lead and zinc were being delivered in the United States considerably under the U. S. price.

Research Program Established

One bright spot on the horizon concerning these two metals is the activity which occurred during 1957 whereby an arrangement among both domestic and foreign producers established a new international joint research program to increase the use of lead and zinc. Admittedly, it will be some time well in the future before such a research program can show any concrete results since this is a long range project.

Under such adverse economic conditions, U. S. operators were forced to curtail exploration and development programs. Thus, there were few, if any, significant new discoveries during the year as producers were required to meet the more pressing problems of curtailment, closures, or highgrading—depending on their individual economic situation.

At the year end, all segments of the industry were anxiously awaiting the Tariff Commission's finding and report.

URANIUM

(Continued from page 89)

definitely established, would be only a step—although an important one—in the long-range effort to develop thermonuclear (fusion) reactors for the production of economic power." Clearly, it would be hazardous to predict either the period required to attain controlled fusion power or the economics of fusion, if developed. With regard to the long-range uranium re-

quirements for military purposes, the development of a great variety of weapons and uses could create even greater markets than now visualized.

Industry seems generally to agree that the present domestic procurement policy will result in sufficient production to meet the Commission goals by 1966. It also will result in a marked decline in exploration activity and reserves, barring fortuitous discoveries. Thus, although the short-range domestic position appears safe, the long-range production, at the pro-

jected 1959-1960 rate, is dependent upon continuing discoveries. Abroad, particularly in the Union of South Africa and in Canada, reserves are, in general, ample to sustain production at the contemplated rates for 20 or more years. In the Free World the uranium industry is still largely dependent upon the U.S. Atomic Energy Commission. Until the nuclear power industry is in a position to offer a substantial market, the only support which the industry has is that which it receives from government agencies.

Industrial Minerals

—where small businesses make a big industry—Its diversified activities continued through the year with amazing vigor

By J. L. GILLSON

Chief Geologist, E. I. duPont de Nemours & Co.

ALTHOUGH general business in many lines was off at the end of the year, most of the industrial minerals concerns operating in the field had had a fairly good year, and there was no slackening in their research and development work on new products.

A large group of industrial mineral products is concerned with activities in the building industry. Construction outlays for 1957 showed the first slow-down in 12 years. Estimated dollar total of construction in 1957 was only three per cent above 1956, and the physical volume was about the same. Private housing activity, due mostly to a shortage of mortgage funds, was down ten per cent, but public construction was up, due principally to increases in highway and school construction. The public utility companies accounted for the largest dollar increase in the private sector.

Another group of industrial mineral producers serve the steel industry, and as this industry was off during the latter part of the year, suppliers of fluxing stone, refractories and fluorspar were affected. The chemical industry had a good year and that kept some producers going well. The fertilizer business was good. Perhaps the worst decline of the year hit the producers of ores for titanium metal,

when the government stopped buying and the producers had to depend upon the limited private demand.

ABRASIVES—Most of the developments during the year were concerned with synthetic products. G. M. Friedman of Stanolind Oil & Gas Co. wrote a paper on the nature, occurrences and uses of emery in *Mining Engineering* for July. Only 11,000 tons of corundum were produced in 1956, mostly in Southern Rhodesia and the Union of South Africa.

Other developments in synthetic abrasives deal with silicon carbide, tungsten carbide, boron nitride, and what are called "ceramic bits."

A new type of abrasive which the manufacturer, Skil Corp., believes will make sandpaper obsolete is prepared by fusing tungsten carbide grits on thin steel sheets which can be made into "blades" for circular saws or use on portable electric drills. A block hand sander for home use is guaranteed to last indefinitely. If the abrasive clogs, it can be restored with a solvent, or a wire brush.

Advances in coated abrasives were reported by Minnesota Mining and Manufacturing Co. in the *Journal of Commerce* of Oct. 3. "Self lubricating" mineral coatings are deposited by electrostatic methods on a nylon mesh backing. The company claims a great improvement in the bonding resins which hold the mineral to its backing.

Boron nitride, a material being produced by the General Electric Co. under the name of "Borazon", is said to scratch diamond with ease and to withstand temperatures up to 3500° F. The probability that the cubic form of BN would have a hardness rivaling the diamond was predicted as long ago as 1923. The developer, Robert Wentorf describes the material as granular, made of tiny black, brown or red crystals. They are not yet in commercial production.

The "ceramic bit" made by the Carborundum Co. can be soft-soldered to tool shanks, or attached with epoxy resins. The Carborundum Co. has been doing a very large business, and early in the year announced a 33 million dollar expansion, which would include a new abrasive wheel plant at Logan, Ohio, another at Van Wert, Ohio, and expansions in silicon carbide capacity both at Niagara Falls and at Vancouver, Wash.

The Norton Co. of Worcester, Mass., announced an expansion of its Canadian plant at Cap-de-la-Madeleine, Quebec, for the manufacture of silicon carbide.

AGGREGATES—A questionnaire submitted early in the year by the National Sand and Gravel Association to 1597 companies was answered by 604. The average production (in 1956) of the reporting company was 397,012 tons. The 604 companies produced 104,970,811 tons of sand valued at over 105 million dollars, an average value of \$1.00, and 134,824,523 tons of gravel valued at over \$160 million, with an average value of \$1.19 per ton. Eleven companies reported individual production of more than 3,000,000 tons, while 75 per cent of the companies produced only 25 per cent of the total.

The importance of the aggregate industry to our National economy may be illustrated by examples of major construction. Dams include one at Noxon Rapids on the Clark Fork in Montana; the Swift Dam of the Pacific Power and Light Co. on the Lewis River in southern Washington which is to be the world's highest earth-filled dam; one on the Arkansas River at Dardanelle, Ark.; another on the Little Red River near Heber Springs, Ark.; the Hills Creek dam on the Willamette; the Rocky Reach on the Columbia; the Wishon and Courtright dams in California; the Dalles and the John Day on the Co-



Joseph L. Gillson has long been an authority on industrial minerals. Through his efforts in part, the mining industry's interest in this field has been intensified in recent years. Consequently Joe Gillson's vast knowledge of the geology, economics and exploitation of non-metallic minerals

and his ability to analyze and present this information have earned for him ever-increasing acclaim and stature by his colleagues in the mining industry.



Astronomical amounts of aggregate are used every year. The huge road building projects that are already underway will be major consumers of this important material

lumbia; the Priest River dam being built for the Grant County Public Utility by Merritt-Chapman and Scott; the Oahe on the Missouri; Flaming Gorge on the Green and Glen Echo Canyon on the Colorado. Fifty odd projects for the military were listed in the *Engineering News Record* in August. Of course, the largest project underway in 1957 was the St. Lawrence Seaway. By Sept. 1, 66.1 per cent of the American portion was completed. The big job of flooding Long Sault Canal must be done before next July, and all structures and channel work must be ready for this event. Many contractors underestimated what it would cost to excavate glacial till and marine clay and several have lost money.

Approved in the November elections were \$614 million of bonds for public works.

Perhaps the biggest news in the construction industry was the highway construction program, which did not move nearly as fast as had been anticipated, when the 1956 act was approved.

The rapid growth out into the country with consequent zoning laws has seriously restricted the operation of sand pits and rock quarries. At the National Industrial Sand Association meeting at Hot Springs, Va., in May, it was stated that the zoning problem is the largest single one that faces the natural resources industries in the near future.

The increased use of heavy media separation methods in cleaning gravel and crushed stone was described in the pages of this Journal in June by Prof. F. F. Legg of the University of Michigan, and W. L. Price of the Dravo Corp. in November. There is a trend toward more rigid gravel specifications.

A new method of eliminating soft deleterious material was developed by the Whittaker and Gooding Co. near Ann Arbor, Mich. The process makes use of the fact that soft materials have elastic properties widely differ-

ent from hard and sound stones. The gravel to be graded is delivered by a feeder onto an inclined plate, and it is the bounce of the stones from this plate that separates the good from the poor. The equipment is being marketed by the Blaw-Knox Co.

A dramatic day in July occurred when Morrison-Knudsen Co. detonated 1,700,000 lb. of explosives at Promontory Point, in Great Salt Lake to provide rock fill for the Southern Pacific's causeway now under construction.

ASBESTOS—Prices of Canadian products moved up appreciably during the year as shown by the following figures:

Quebec Mines	U. S. Dollars/Tons	
	Jan. 57	Dec. 57
Crude No 1	1400-1725	1543-1900
Crude No 2	750-1100	823-1212
Spinning fibers	350-650	371-619
Single fibers	190-210	200-231
Paper stock	114-137	126-149
Waste	82-84	86-90
Shorts	28-75	28-79

British Columbian high grade was not quoted in January. In December No 1 crude was quoted at \$1598 and AAA grade at \$920. Vermont quotations were unchanged during the year.

In Quebec, Canadian Johns-Manville, which contributes about 60 per cent of the Canadian output, is located at the town of Asbestos in Richmond Township. At and near Thetford Mines in Megantic township is the Asbestos Corp., operating the King open pit and underground mines, the Beaver and British Canadian open pits and the Normandie pit. Adjoining, are the Bell Asbestos and Johnson's Asbestos Co. The latter also operates a large open pit at Black Lake. Other producers in the area are Flintkote Mines, Quebec Asbestos at East Broughton and Nicolet Asbestos which adjoins Johns-Manville. National Asbestos, a subsidiary of National Gypsum Co. is developing an ore body on the Pennington dike and constructing a 3000-ton mill. Carey Asbestos is building a 2000-ton mill and developing a new ore body near

East Broughton in Bouce Township. At Black Lake, a few miles south of Thetford Mines, Lake Asbestos, a subsidiary of American Smelting and Refining Co., is developing a large deposit, to accomplish which it has had to drain Black Lake.

In northwestern Quebec there is a new property on Asbestos Island, 11 miles east of the town of Chibougamau. It is estimated to contain about 8,000,000 tons of asbestos bearing rock having a value of \$8.73 per ton. The C.N.R. was expected to have its rail line into Chibougamau by June.

In western Quebec, Eastern Asbestos has ordered the equipment for a 250 tpd mill at Notre Dame de la Salette.

Developments and activities in the Eastern townships have been much in the news, particularly concerning the major development by Lake Asbestos. Its plant is expected to be in operation by the middle of 1958, on the scale of 100,000 tons of fiber annually.

Johns-Manville, which just finished its big mill in August 1956, is spending another \$2,000,000, and the next largest producer, the Asbestos Corp., is modernizing. It closed its King and Beaver Mines, to reopen in July 1958, and is enlarging its mill at a cost of \$5,000,000. When all of the new plants are in operation, the total rated capacity will be 59,700 tpd.

Johns-Manville is still deepening its shaft at Monro, Ont. Two new Canadian finds are in Newfoundland and in the Yukon. In Newfoundland the Advocate Mines holds ground in the Baie Verte area. Its reserves are estimated at 30,000,000 tons valued at \$8.17 per ton. The property in the Yukon is 30 miles from Dawson City and is held by Conwest Exploration, the parent company of Cassiar which operates in British Columbia.

Cassiar Asbestos mine is located 86 miles south of Watson Lake on the Alaska Highway. A new aerial tramway was completed a year ago, and now the company has bought six trucks. The mill produces a long fiber, low iron asbestos. Newmont Mining Corp. owns 17.1 per cent of the company. The 1956 production had a value of \$7,000,000.

The total Canadian production of asbestos is about \$110,000,000.

Arizona produces a low iron chrysotile asbestos. The mines in Gila County were shut down for three months, but a renewal of the stockpiling program to June 30, 1958, has stimulated their reopening. Presumably though, the activity will not last long. Mining and milling at the Regal Mine of the Jaquays Mining Co. was decreed in *Mining World* for July. The largest shipper has been Metate Asbestos Co. on the San Carlos Indian Reservation.

In Italy, Vittore-Balangero, in Torino, doubled the mining and milling rate of its open-pit operation. Production is now at the rate of 32,000 tons of fiber per year. This is 53 percent of the asbestos produced in Western Europe. Kennecott Copper Corp. is exploring an asbestos deposit in Greece.

There was not much news from South Africa. The Kliphuis crocidolite deposit was described by W. E. Sinclair in the *Bulletin of the Institution of Mining and Metallurgy* for December 1956. Star Asbestos, in the Eastern Transvaal, has started operations with a capacity of 3600 tpd. Stoltzburg Asbestos Holdings Ltd. has formed a marketing agreement with French asbestos consumers. Msauli Asbestos Mining and Exploration produced 7510 tons of fiber from 164,800 tons of rock milled. Associated Asbestos Ltd. is expanding output of blue asbestos from its Pietersburg deposits.

Southern Rhodesia, which ranks next after South Africa, produces a chrysotile asbestos which is claimed to be the finest in the world. Its value exceeds that of any other mineral produced in the Colony. Half of the production goes to England, and only a relatively small proportion to the United States.

The crocidolite deposits of Witteboom Gorge, northwestern part of Western Australia, were described in the *Chemical Engineering and Mining Review* of Melbourne for Nov. 15, 1956. About 8000 tons of fiber are exported annually, with a value of £800,000.

On the fabricating side of the asbestos business, Johns-Manville has spent about \$35,000,000 on plant expansion. This was described in its 1956 annual report. The company did a gross business of \$310,390,000 in 1956, on which it earned \$25,003,000. Twenty-six plants are listed in the United States and Canada. The slump in the domestic building industry caught J.M. in the middle of its big expansion, and its profits for the first nine months were off 32 percent.

BARITES—Out of a total world production of barites in 1956 of 3,000,000 tons, the United States produced 1,351,913. West Germany was second with 435,836 and Canada, third with 307,808. Rather surprisingly, Mexico was fourth with 235,792 tons. The U.S.S.R. is credited with 110,000, followed by Italy with 101,185, United Kingdom with 86,297. Peru and France were the only other countries producing over 50,000 tons.

The big deposits at Walton, Nova Scotia, were described by M. G. Goudge of the Nova Scotia Department of Mines in the *Bulletin of the Canadian Mining Institute* for December. The new development there is the sinking of a shaft to a depth



Borax and borate mining has suddenly burst forth into the jet-propelled age because of energetic research that has found new uses for boron. Pictured is the new pit of U. S. Borax and Chemical Corp.

of 729 ft, with levels established at 350, 520 and 629 ft. Direct shipments are made to processing plants in Houston, Texas. A modern mill is planned at the mine site to replace the one at the pier. A new deposit in Nova Scotia is being prospected by the Magnet Cove Barium Co. This is in the Cobequid Mountain area of Colchester.

A description of the open pit mine and processing plant of the Macco Corp. near Inyokern, Calif. was published in *Rock Products* for April. The ore occurs as a wide vein in granite.

The American Colloid Co. has purchased seven barite claims on Dry Creek, 50 miles north of Wells, Nev.

The Peruvian deposits were described briefly in *Mineral Trade Notes*, vol. 44, June 1957, Peruvian Chemicals Co. is the leading producer from deposits in the Rimac River Valley, about 31 miles east of Lima. The company has a grinding plant in the Lima-Calleo area and another at Talara. The ground product has a specific gravity of 4.3, which is exceptionally high. Cia. Minera Nor-Peruana owns the extensive Suyo deposits close to the Ecuadorian border. The output is used in Peru, by the International Petroleum Co. Mina Mercedes, in the interior of Chiclayo; it was formerly of importance but is now nearly exhausted. Several other deposits are known in the country but have not been explored.

Two plants in Venezuela were under construction in the district of Bolivar, State of Zulia. No information is given about the deposits. Cuban deposits were described in *Mineral Trade Notes* for July 1957, p 24. There are two producers both working deposits on the north coast of Pinar del Rio province. One is the Mora Co., the other the West Indies Iron and Metal Co. Shipments are made through the ports of Santa Lucia and Mariel.

Most of the Mexican barite comes

from deposits in the Lower Cretaceous limestone near Muzquiz, Coahuila.

In Greece a joint venture by the Magnet Cove Barium Co. and the Mykonos Mining Co. on the island of Mykonos has established a mill for grinding barite.

A deposit in Southern Rhodesia, 11 miles south of Que Que, have been reported in *Mineral Trade Notes* for February. A plant at Quern in South Australia was put in operation in April. Barite is mined in the Flinders Ranges, 60 miles northeast of Hawker. This is said to be the only high grade deposit in Australia.

The mine at Gleniff, County Sligo, in Ireland, has been worked by the Benbulbin Barytes Ltd.

BENTONITE—A relatively new but important market for bentonite has developed as the binder for pelletizing taconite concentrates.

The National Lead Co. has built a laboratory at Lovell, Wyo., to test bentonite samples collected from a group of claims east of the town.

BERYL—In 1956 the world production of beryl was 12,500 tons of which India produced 3360, Brazil 2000, Argentina 1722, Belgian Congo 1800 and Mozambique 950. The U.S. production was only 460 tons, which was down from a peak of 751 in 1953.

Intensive prospecting is under way by Dalhart Minerals Corp. in the Winnipeg River area of southeastern Manitoba, and in the old Boomer Mine, near Lake George Colo., by a group from Colorado Springs.

A process for selectively chlorinating beryl ore has been patented in the name of W. W. Beaver. The patent No. 2,789,880 has been assigned to the A.E.C.

The Brush Beryllium Co. is completing a plant near Elmore, Ohio, at a cost of \$4,500,000 to produce oxide and metal, and the Beryllium Corp. started up a new plant at Hazleton, Pa., to produce billets for the A.E.C.

The process of prospecting for and then developing pegmatites for beryl and other minerals was described by Peter Weidner, a South African, in the *Mining World* for June.

BORAX AND BORATES—Although widely used for years by the glass and ceramic industry and to a smaller extent in the detergent field, borax and borate mining has suddenly burst forth into the jet propelled age. Organic compounds of boron are high energy fuels; the isotope of boron, B-10 is used as an absorbant of neutrons, products of nuclear fission, and an organic boron compound is used as a gasoline additive. Borax and boric acid are used as a fire extinguisher or fire retardant, as a weed killer, and in a host of other ways. The annual production of crude borax, about a million tons a year, is still going principally into the old line uses, but the producers anticipate a doubling of the demand in the next ten years.

There are three principal producers: the Pacific Coast Borax Co. Div. of the recently formed United States Borax and Chemical Co. which in June started production from an open pit at its property near Boron, Calif.; the American Potash and Chemical Co. at Trona, Calif. producing brines from the north end of Searles Lake; and the Stauffer Chemical Corp. which bought out the old West End Chemical Co., working at the southwest end of Searles Lake. Deposits in Death Valley and Furnace Creek are no longer worked.

In a \$20,000,000-project U. S. Borax and Chemical Co. replaced, or stated more accurately, supplemented its very efficient underground mining operation, which used Joy continuous miners with shuttle car and belt haulage, with an open pit after removing 10 million tons of overburden in two years. It also built a new refinery, three miles from the pit, to replace the old one at Wilmington, Calif., 209 miles away. The geology, mining and concentration are well described in an article in *Mining Congress Journal* for May.

Operations at Searles Lake were described in detail in *Industrial and Engineering Chemistry* for March.

Diborane, B₂H₆ releases 16,000 calories per gram, when burned, as compared with 8000 calories per gram of coal. B₄H₁₀, decaborane, is made by heating diborane to 125° C. This is the starting point for most research in the field of borane fuels. So far these compounds are so expensive that it is unlikely that they will be used in commercial fields for some time.

The isotope B₁₀ which now sells for about \$1500 per lb is 20 times more effective than lead in reactor shielding. It is produced by the Hooker Electrochemical Co. at Niagara Falls.

The alkyl boranes, also high energy

fuels, are to be produced at a new \$38,000,000 plant of the Callery Chemical Co., at Muskogee, Okla. Gulf Oil Co. purchased a 25 percent interest in Callery from its parent, Mine Safety Appliances Co. The Muskogee plant was financed by the Navy under its project "Zip." Callery has announced still another plant to be built at Lawrence, Kan.

Olin Mathieson Co. is also heavily committed in the field of the boron high energy fuels. A year ago it announced a \$36 million plant at the Lake Ontario Ordnance Works at Model City, N. Y. Two new plants are announced at Niagara Falls. In one of these a new process using sodium borohydride, supplied by Metal Hydrides, will be used.

Chemists express words of caution about the use of boron compounds in aircraft flying over land. A product of combustion is B₂O₃, a solid which many agricultural plants can tolerate only in very small concentrations.

In addition to the uses described above, the boron esters are described as having almost fantastic synthesis producing powers.

BROMINE—Although the value of the bromine produced principally from brines by the Dow Chemical Co. continues to rank high in the total of industrial minerals, there was little in the news in 1957. The small Michigan Chemical Co. reported that its new bromine plant started operating in February.

CALCIUM CHLORIDE—While its use as a soil stabilizer is not new, a boost in publicity has resulted from its use in the erection of the 60-story Chase Manhattan building in downtown Manhattan. To provide protection against ground water during excavation, a gel is made by mixing 0.8 gal of the chloride with one gal of sodium silicate. Fifteen-man crews worked around the clock pumping the mixture into the ground.

CLAYS—Clays and clay products are another large segment of the industrial mineral field, but they seldom make news. The Sixth Annual Clay Conference was held at the University of California in August. The Illinois State Geological Survey published a report on the pottery clay resources of the state. National Clay Pipe Manufacturing Association is building a new research building and laboratory at Crystal Lake, Ill.

The J. R. Simplot Co. of Idaho is building a million-dollar clay processing plant at Bovill, Idaho, to use the clays of Latah County. The Anaconda Co. is prospecting a large area near Deary, Idaho, with the hope of finding a raw material for the production of alumina for its aluminum reduction plant at Columbia Falls, Mont.

CERAMICS—The outstanding development in the ceramic field during the year was a product of the Corning

Glass Works named Pyroceram. The material was described in detail in many publications but articles in the *Ceramic Bulletin* and *Chemical Engineering Progress*, both for July are adequate. This material differs from glasses in that it is essentially crystalline, and from other ceramics in that its crystalline structure is much finer. Pyroceram is melted and formed like glass, but with a formula containing one or more nucleating agents. The first use suggested for the material is on the radomes for guided missiles; a use in which its strength, hardness, temperature resistance and dielectric properties are adapted. It may be used also in chemical and oil refining to withstand corrosive liquids at high temperatures, jet engine parts, and cooking ware. As compared with Pyrex glass, Pyroceram has a higher softening temperature (1300°C vs. 820°C), twice the modulus of elasticity, and four times the modulus of rupture—besides being much harder and offering greater abrasion resistance.

Other new products, made of uranium and thorium oxides, are called ceramic fuels. These are molded into shape like dog biscuits, and fired so that the oxides fuse together. The pellets are made by the Norton Co. and are shipped to the Argonne National Laboratory for use in boiling water reactors. Each pellet, of the diameter of a large pencil and perhaps an inch long, has the energy of several tons of coal.

Ceramic coatings to protect aluminum alloys exposed to high temperatures have been developed by Gulton Industries and the Lithium Corp. of America. The material is a lithium chromate, lithium borosilicate and lithium fluoride compound. Also, the Aluminum Company of America has announced a porcelain-enamel aluminum foil. The material can be drilled, nailed, sawed or cut, and the color range is unlimited.

DIAMONDS—Since the General Electric Co. first announced manufacture of artificial diamonds, it has now produced 100,000 carats and plans to step up the production to 3,500,000 carats annually. The product currently sells for \$4.25 a carat compared to \$2.85 a carat for the natural product, of the same size, and if bought in large quantity. The largest stones made are about 0.1 carat. Diamonds the size produced by G.E. are used largely in grinding wheels for shaping tungsten carbide tools.

The latest world diamond production figures are for 1955. As usual the Belgian Congo produce over 60 percent of the total world production, South Africa 13 percent, and the Gold Coast a little over 10 percent. The countries outside of Africa produced less than two percent of the total. In October 1957 De Beers Consolidated

Mines stated that diamond sales through the central selling organization, for the first nine months of 1957, totaled £59,136,053 of which £40,554,090 represented gem stones.

A report on the activity of Consolidated Diamond Mines of southwest Africa for 1956 stated that 24.9 tons were stripped per carat recovered, and that the average size of stone was 1.01 carats.

In South Africa De Beers Consolidated Mines Ltd. is building a £2,000,000 treatment plant, centrally located to the Bulfontein and Wesselton mines. The Bulfontein output will also include the diamondiferous ore from the adjacent Dutoitspan mine which will be brought to the Bulfontein shaft by underground haulage. *Mineral Trade Notes* for May gives average production in Angola as about 740,000 carats, but the yield per cubic meter has dropped from 0.60 carats in 1951 to 0.42 carats in 1956. Israel is becoming an important producer of polished stones.

DIATOMACEOUS EARTH—The United States produces nearly half of the world's total diatomaceous earth. Denmark, which is not noted as a mineral producer, is the second most important country with nearly 20 percent of the total. West Germany and France are the only other substantial producers. Last year saw a new diatomite operation in Oregon started for the Great Lakes Carbon Co. in northern Lake County. The product is hauled to the company's processing plant at Lower Bridge, Deschutes County. Also, the Johns-Manville Co. started marketing a new filter aid called "Fibra-Flo," a mixture of asbestos and diatomite.

FELDSPAR AND NEPHELINE—The world production of feldspar for the period 1947-56 is given in *Mineral Trade Notes* for August. The United States produced 622,289 out of 1,155,000 tons of the world's production of feldspar in 1956. West Germany was second with 172,718, France was third with 70,000. Norway, Italy, Sweden and Japan each produced about 50,000 tons.

Canada has been a minor producer of feldspar from the Buckingham district in Quebec, but a new and very large operation has been started by the Spar Mica Corp. Ltd. on the north shore of the St. Lawrence near Bay Johan-Beetz 600 miles northeast of Montreal. The pegmatite in which it occurs is one-half mile wide by 5½ miles long. The company has spent nearly \$4,000,000 in the last 2½ years to bring the mine and mill into production. The mill has a capacity of 200,000 tons of crude rock a year and can discharge directly into ocean-going vessels. The first shipment of 4000 tons of glass grade spar was made to Camden, N. J., in the fall.

One hundred eighty-four occur-

rences of pegmatites have been reported in the State of Maine. In New Hampshire, the Foote Mineral Co. has purchased feldspar deposits and a grinding mill in the vicinity of Cold River. In North Carolina, the Lawson-United Feldspar and Minerals Co. has rebuilt the old plant of the United Feldspar Co. and plans to produce feldspar, quartz and mica—principally from the alaskite rock that occurs in the area.

International Minerals and Chemical Corp. with mines and plants at Kona and Spruce Pine, N. C., has reduced the price of glass grade feldspar from \$12.50 to \$10.00. The company has just received a patent on the electrostatic separation of feldspar without the addition of preferential surface wetting agents or chemical reactants.

Operations of the American Nepheline Co. at Blue Mountain, Ont., were described in *Mining Engineering* for November. The new plant at Nepton which cost \$2.5 million started operations in mid-1956. Another description of milling and process methods was given in the *Bulletin* of the Canadian Institute of Mining and Metallurgy for July, and screening problems were described in the *Canadian Mining Journal* for the same month.

Two ceramic papers on the use of nepheline are given in the *Bulletin* of the American Ceramic Society, one concerning its use with talc and ball clay, and one concerning its use in porcelain bodies.

FLUORSPAR—The U. S. Geological Survey came out with a new estimate of fluor spar reserves in the United States, as of October 1956, as follows:

	Measured and Indicated	Inferred	Total	Approximate percent
Illinois-Kentucky	8,100,000	4,000,000	12,100,000	54
Colorado, Idaho, Montana, Utah, and Wyoming	4,500,000	3,700,000	8,200,000	36
New Mexico, Arizona and Texas	800,000	700,000	1,500,000	7
California, Nevada and Washington	400,000	350,000	750,000	3
New Hampshire, Tennessee and Alaska		10,000	10,000	

The world production of fluorspar for the period 1947 to 1956 was given in *Mineral Trade Notes* for September. The year 1956 was the first time that the United States was not the leading producer of fluorspar, Mexico having edged it out by 360,117 short tons to 329,719. West Germany was third with 170,858, followed by Canada with 151,738, Italy 136,675, U. S. S. R. 110,000, East Germany with 90,000 and France with 89,000. Furthermore, statistics for the first half of 1957 have just been released. The imports from Mexico of metallurgical grade totalled 107,350 tons in the first six months, about equal to the 1956 rate. Consumption of acid grade in the first six months was 160,701 tons, well above the 142,590

tons used in the steel industry and by foundries. The first year that the acid grade consumption exceeded that of metallurgical grade was 1956.

The only quoted change in the price schedule was a reduction on Dec. 1 of the price of acid grade from \$55 to \$50. Actually, so much of the spar is sold on long-term contracts that the quoted prices are only nominal. The slackening in the rate of open hearth operations during the latter part of the year caused a slump in the demand for metallurgical grade.

Two producers of long standing shut down during the year. The St. Lawrence Corp. in Newfoundland, having completed its contract with the U. S. Government to supply acid grade, shut down the flotation plant at Wilmington, Del., and its mines on the Burin Peninsula. At Fallon, Nev., Kaiser Aluminum and Chemical Co. shut down its mill and the mine near Gabbs.

Although the producers in the Illinois-Kentucky district were complaining of competition from Mexico and trying to have a bill passed imposing a quota on imports, there was a considerable amount of activity in the area. The old Pigmy mine, near Mexico, Ky., was put back into operation and the Mackey-Humm Co., now under option to Roberts and Associates has installed a flotation plant at its mill on the Illinois side. A new company, Green Fluorspar Co. has sunk a 300 ft shaft on the Ora Spivey property in Hardin County. Alcoa is continuing some development work on a bedded deposit in Livingston County and has bought the old Lost 40 property in Pope County. Alcoa is still working the Blue Diggings and Good Hope veins, although the former is

pinching in depth, and a great deal of water has to be handled in the second. Ozark-Mahoning has a new mine called the Hill-Ledford, a bedded deposit in the upper part of the Fredonia. The ore is reached by a shaft 803 ft deep. The company is also working the Oxford deposit and the No. 16 mine as well as the West Green, and is milling about 600 tpd of ore. Minerva Oil Co. is one of the most active in the district, working its No. 1, the Crystal-Victory and the Jefferson. Some of these ores are high in zinc. Pennsylvania Salt and Manufacturing Co. operates the Dyers Hill vein, and is said to have found some additional reserves. Its mill in Mexico, Ky., produces both acid grade spar and lead and zinc sulfide concen-

trates. Production of metallurgical grade spar in the district has practically ceased, because of severe Mexican competition.

Outside of the Burlington mine at Darby, Mont., which works the Burlington mine only in the summer, and an operation at North Gate, Colo., there is very little activity in the mountain states.

Mexican fluorspar producers keep very busy in a number of places. In Coahuila, just south of the Texas border there are five centers of activity: Pico Etereo, the San Vicuta-Borquillas area, the Encantada-Buena Vista area, El Tule and the Paila area. In San Luis Potosi, there are two areas. At Zacualpar in the State of Guerrero, the General Escobedo mine is producing a high quality of acid grade by flotation.

As to the mines in Coahuila, production in the Pico Etereo area is fairly recent. There four mines are in production, all at or near contacts of rhyolite with the upper part of the Georgetown limestone. There is a small mine operated by Rene Amezuca, most of the ore coming from bedded deposits called "mantos"; a mine belonging to Bishop Bailey on Mal Abrigo Mountain; a deposit belonging to the Enriquez brothers, under option to the Reynolds Metal Company; and the Quatras Palmas mine belonging to the Dow Chemical Co. Further to the southwest Dow has a spectacular deposit from the point of view of scientific geology. There is an elliptical dome of turned-up sediments, five or six kilometers long, and two to three wide. The rim rises to a height of 750 meters or so above the plain, and inside there is a collapsed core. In a sill of rhyolite, intruding the limestone around the edge of this collapsed core, the fluorspar occurs. Later, in the center of the collapsed core, a plug of syenite was pushed up like the spine of Mt. Pelé.

The fluorspar in all of these deposits in contact with the rhyolite is fine grained, high in lime, but low in silica. By some careful sorting it is simple to ship a metallurgical grade. The Reynolds Metal Co. intends to ship the output from the Enrique mine to its flotation plant at Eagle Pass, Texas.

There is intensive activity at Encantada and Buena Vista, by Fluorita de Mexico. The bulk of the ore, about 300 tpd needed to feed the flotation plant at Muzquiz, is coming from the manto type deposits in these mesas. Here the ore occurs at the very top of the Georgetown, either in the limestone or in the Del Rio shale.

At El Tule, the ore occurs in similar mantos, and probably at the same horizon, but the average thickness is less, being perhaps 60 centimeters rather than a meter or more as at Encantada. Both the Encantada and El Tule ore is coarsely crystalline,

and very easily concentrated by flotation to acid grade.

Production at the Paila district is less active because of the high lime content, and its intimate admixture with the fluorspar has proven difficult to concentrate. Asarco, Reynolds Metal, and a subsidiary of the St. Lawrence Fluorspar Co., called La Julieta, have properties there.

In the Zaragosa area, in San Luis Potosi are two important mines which have been supplying a large part of the metallurgical spar used in the United States during the last couple of years. First there is the Consenting mine belonging to Penn Salt International, the Mexican subsidiary of which is Minerales y Metales Industriales. The ore occurs in limestone close to a fault contact with the rhyolite, and is worked in a series of benches. The ore is easy to sort to metallurgical grade and requires no mechanical concentration.

The neighboring mine belongs to Cia Minera Las Cuevas, which is a Mexican subsidiary of Noranda of Canada. Empresa de Nicaragua has the managerial contract. The actual acquisition of the mine by the Noranda subsidiary has been very recent, and most of the mining difficulties facing the management are due to the former owner. The ore is in the rhyolite, close to the limestone contact, rather than in the limestone. It seems to occur as a pipe, and is worked by underground methods on several levels. Drilling has shown that the ore continues in depth at least under part of the zone. The decomposed rhyolite makes heavy ground in wet weather, and several "cave-ins" have occurred. Some of the ore is very high grade, and acid grade lump can be sorted and shipped.

South of Rio Verde near Zepote is a mine worked under the name of Empresa Minera. The ore is in decomposed rhyolite, in a cone-like shape, with limestone walls. It has many of the features seen at the Azul mine near Tasco, which some geologists think is a replacement of the filling of a sink hole. The original working is nearly exhausted, but other deposits have been found.

Over the mountains into Guanajuato, Cia Minera Helios works a deposit which is a replacement of limestone near the rhyolite contact. The ore is similar to the others in this contact relationship, and metallurgical grade is produced easily by sorting. About 700 tpd are shipped 77 kilometers over rugged terrain to Rio Verde.

Several other items of interest in the fluorspar and fluorine industry developed during the year. Two patents were issued on the recovery of fluorine from phosphate rock. One was issued to Smith Douglas Co. of Norfolk, Va., and covers the treatment of ground phosphate rock with

a reducing agent, such as coal, in a chlorine environment. The fluorine and phosphorus are volatilized and recovered. The other involves the treatment of phosphate rock with sulfuric acid, and the resulting HSiF_6 is treated with marble dust. Filtering produces a calcium fluoride cake containing silica gel. The patent is assigned to International Minerals and Chemical Co.

Chemists of TVA have worked out several ways to recover fluorine from phosphate rock in usable form, and at competitive prices.

Fluorine compounds as well as fluorine gas itself are mentioned among the high-energy fuels. The compounds are oxygen difluoride, nitrogen trifluoride and an ozone-fluorine product. Allied Chemical and Dye Corp. has released a bulletin entitled "Fluorine Tamed for Rockets." The same company is building a plant near the Illinois fluorspar district to make UF_6 for the AEC plant at Paducah, Ky. At Baton Rouge, La., Allied makes SF_6 which is used as an insulator in electrical transformers, X-Ray and TV tubes, etc. because the compound has a dielectric about equal to transformer oil. It is used also as a sonic barrier in wind tunnels because of its density.

GEMS—The old Yogo mine in Judith Basin County, Mont. was reopened a year ago, and this summer a 5½-carat blue sapphire was found.

An old "emerald" mine near Little Switzerland, N. C., has been reopened. It has been worked off and on since 1855.

Bell Telephone laboratories has developed a new process to grow synthetic sapphires. Bell makes sapphires by filling a small, silver-lined autoclave from 70 to 80 percent of its free volume with one molar sodium carbonate. Reagent alumina, or aluminum hydroxide, go into the bottom of the reaction cavity and seed crystals cut from a cerundum bar are suspended on a silver frame in the top. The nutrient dissolves in the sodium carbonate at 400°C and 30,000 psi, supersaturates it, and then redeposits on the seeds. The resulting crystals are free from strain.

The U. S. Geological Survey published a bulletin (1042-g) during the year that catalogs all of the gem occurrences in the United States.

GLASS—Although not an industrial mineral, glass is made almost exclusively from industrial minerals, and as it is almost a universal material it has found widening uses in all sorts of places. As fiberglass it is used increasingly to make dresses, drapes, bodies for boats and cars, and insulation. The U. S. auto industry buys \$350,000,000 worth of glass a year. With housing-starts down, and the auto industry sales off, some of the glass companies made only slight gains in 1957. The total sales were

Although it may lack the glamour of some of the metalliferous ores, gypsum nevertheless is a real bread-and-butter mineral and is attracting new interest



up only \$28,000,000 to \$1.268 billion in the first nine months of the year. *Forbes* chose to compare Anchor Hocking, Corning Glass, Libbey Owens Ford, Owens Corning, Owens Illinois and Pittsburgh Plate Glass as the big six glass makers.

Some new developments in glass were reported during the year. Pittsburgh Plate Glass started full scale production of Spandrelite glass building panels. The Kimble Glass Division of Owens-Illinois reported the development of a hard boro-silicate glass which has a softening point of 1508°F, and its expansion is much less than that of steel. The Corning Glass Works makes a "Fotoform" glass with 360,000 holes per sq. in. used in color TV. Dow Corning makes a new safety glass using a silastic interlayer which has the much higher heat resistance required in fast flying military aircraft.

In the fiber glass field there were many developments. Pittsburgh Plate is building one of the world's largest continuous fiber glass yard plants at Shelby, N. C., with a capacity of 25,000,000 lb per yr. Libbey Owens Ford is building a similar plant at Laurens, S. C. Owens Corning announced a new glass fiber called Aerocor with a fluffier feel and tufted appearance. Curtains made of it can be washed and hung without ironing. The same company is promoting fiberglass in the insect screen field. Approximately 55,000 boats built in 1957, in sizes up to 30 ft in length, are molded of fiber glass and resin. Libbey Owens Ford's Corrulux Division has introduced a fire resistant structural panel made of glass fiber reinforced by a polyester resin. The panels transmit light, but are strong and shatter proof. They are made in various colors.

GRAPHITE—As to world production of graphite, Korea led in 1956 with 67,367 short tons, followed by Mexico with 32,655, Austria with 20,597, Ceylon with 16,787 and Madagascar 15,916.

A new mill in Korea at the Sihung graphite mine in the province of Kyonggi Do has been financed. The deposit is said to have a reserve of 20,000,000 tons and the new mill will produce 2400 tons annually.

Union Carbide Co. has announced a new graphite electrode plant at Monterrey, Mexico.

GYP SUM—Writing in *Mining Congress Journal* for March, J. F. Havard of the Fibreboard Paper Products Co. said, "Gypsum is . . . processed on such a large scale and is the basic raw material for such great enterprises that it is attracting new interest."

About 75 percent of the U. S. demand for gypsum is supplied from domestic deposits. Nova Scotia supplies about 22 percent, and the remainder comes from Mexico, Jamaica and the Dominican Republic. Out of a world production of 34,200,000 tons, North America supplied 15,867,000, and Europe was next with 14,000,000. Kaiser Gypsum has mined and shipped over 300,000 tons per year from Mexico for several years. Also of interest is that the production from Jamaica has been increased greatly because of increased capacity by Jamaica Gypsum Ltd., a subsidiary of the U. S. Gypsum Co.

Because of the slump in the private building industry, all of the companies suffered a loss in sales. However, U. S. Gypsum, which is one of the bluest of the blue chips, maintained its profits per share within five percent of the 1956 level.

In such a large industry with a great many developments, only a few items can be selected in this brief review. National Gypsum began operation of its new Milford Station mine in Nova Scotia in 1956. The same company has been developing its Tawas City, Mich., deposit and expects to be in operation early in 1958. National is continuing its expansion program with two new building products plants to use the Michigan output, with docks and harbors on the lakes. The company also put its new Atlantic fleet of gypsum carriers into operation. Four companies were operating in Nova Scotia during the year. Canadian Gypsum operated at Windsor and Miller's Creek; the Little Narrows Gypsum Co., Ltd. and the Gypsum, Lime and Alabastine Co. operated at Little Narrows. Bestwall Gypsum has been drilling and developing a deposit, and National Gypsum Company's deposits were written

up in the February issue of the *Canadian Mining Journal*.

Bestwall announced plans to build a big plant at Savannah that will use 300,000 tons of gypsum annually.

Western Gypsum Products Ltd. of Winnipeg, a subsidiary of British Plaster Board Ltd. of London, acquired all the capital stock of Westroc Industries of Vancouver, and the bulk of the assets of Columbia Gypsum of Windermere, B.C., and Spokane. From Columbia Gypsum, Western Gypsum acquired the huge Windermere deposit with reserves in excess of a billion tons.

Solvay Chemicals Ltd. of Cumberland, England, is operating an anhydrite plant to make portland cement and sulfuric acid. A review is given in the August issue of *Industrial and Engineering Chemistry* on the status of the process for making sulfuric acid and cement from anhydrite. Information is given on eight plants in Europe.

IODINE—The exports of iodine from Chile during the "crop year" July 1, 1955, to June 30, 1956, were 792 metric tons as compared with 1163 tons the year before. Nearly 50 percent was shipped to the United States.

KYANITE, SILLIMANITE AND ANDALUSITE—Sillimanite deposits in Colorado were described in the *Quarterly* of the Colorado School of Mines in December. The U. S. Bureau of Mines described tests on the production of kyanite-sillimanite concentrates by flotation from the non-magnetic tailings of the ilmenite plants at Jacksonville and Starke, Fla. The grain size of the minerals is too small (around 80 mesh) to be attractive to most consumers.

Kyanite Mining Corp. completed a new plant near Dillwyn, Buckingham Co., Va., and Cleveland Minerals is mining and processing kyanite at Kings Mountain, N. C. The Pallar corundum-sillimanite deposits of South Africa were described in a recent article. The output is shipped to West Germany. Andalusite is also produced in South Africa, the production in 1955 being 19,000 short tons.

LIGHTWEIGHT AGGREGATES—There are two basic types of lightweight aggregates; those made from clay and shale, and produced mostly in the East, and those made from perlite and pumice, and produced mostly in the West.

The manufacture of lightweight aggregate from clay and shale was described in the *Bulletin* of the American Ceramic Society for July. A product called Midlite produced at Brooklyn, Ind., was described in *Rock Products* for June. The Engineering Experimental Station at Ohio State University studied the possibility of extending the lightweight aggregates industry in Ohio. Samples from 58 localities showed promise. Meanwhile

Buildex Inc., a Kansas concern, purchased the Lite Stone Aggregate Co. at New Lexington, Ohio, and a plant at Leaksville Jct., Tenn., was opened on June 1st by the Southern Lightweight Aggregate Co. A Florida plant has been started by Florida Lightweight Products Co. to make lightweight aggregate from phosphate slimes. In New Jersey, Sayre & Fisher Company's Aglite Division began operation of a new plant at Sayreville.

A new lightweight cellular concrete, developed and used in Germany is being introduced in this country by the Elastizell Corp. of Alpena, Mich. It is compounded of a liquid foaming agent and a water-soluble plastic agent. The compounds are added to concrete during the batching to produce a homogeneous cellular structure.

LIME—The National Lime Association held its annual meeting in Austin, Tex., in October. The problems of dust control around plants and quarries were described. Instrumentation in rotary kilns was the subject of one paper which described the operation of the Allis-Chalmers kiln. At a June meeting at Colorado Springs the stabilization of roads with lime was described. The consumption of lime for this purpose has reached 130,000 tons annually. The use of lime in uranium milling and in water treatment were described. Technical progress in kiln operation was discussed and a new high-capacity vertical kiln called the Calcimatic was described. A redesigned vertical kiln of the Electro-Metallurgical Co. was reported able to increase former capacity fourfold. Another vertical kiln, called the Azbe kiln was described at length in *Rock Products* during the year.

Several new lime plants were announced. Chemical Lime of Portland, Ore., opened a \$2,000,000 plant at Baker, and the U. S. Lime Products Co., a subsidiary of Flintkote, has announced an industrial lime plant at Arrolime, Nev.

LIMESTONE—The production of limestone for use as flux stone or for the manufacture of lime and cement is largely in the hands of the companies using the end products, although there are many independent producers of crushed stone for road metal and railroad ballast. The use of California limestones and dolomites, worth \$130,000,000 annually at the mill site was described in this journal in August. The change, by the Riverside Cement Co., of its method of limestone mining from block caving to room and pillar methods, and the use of cyclones at its Crestmore, Calif. operations were described in *Mining Engineering* in April and October. The use of off-highway trucks for hauling 30 to 40 tons at Davenport, Iowa, was described in



Typical of the small operations that make up a large portion of the industrial minerals industry is the two-acre Turner Lime and Rock Quarry in Shelby, Mo.

Rock Products for October, and the production of 250 tpd of ballast rock by the Hanna Coal Co. was also written up. The Warner Co. of Philadelphia has opened a new level in its Bell Mine at Bellefonte, Pa., to work a 60-ft ledge of the Bellefonte limestone. In Florida, where hard rock is scarce, the Oolite Crushed Stone Co. opened a plant at the Richmond Airbase to crush 3000 tpd of the Ocala limestone.

The metallurgist of the Sheffield Steel Div. of Armco Steel Corp. pointed out that a steel production of 120,000,000 tons will require 40,000,000 tons of limestone and lime. Production of fluxstone by the Michigan Limestone Div. of U. S. Steel Corp. at New Castle, Pa., was described in the *Mining Congress Journal* for September. Underground mining of limestone on a scale of 400,000 tons per year is conducted by the Arkansas Limestone Co. which supplies all the requirements for the Reynolds Metal Co. at Bauxite, Ark. An associated company supplies Alcoa from an open quarry.

Agricultural limestone is sold to farmers for neutralizing soils. Currently about 5,000,000 acres are being "limed" at an average cost for the limestone of four dollars per acre; most of this stone is paid for by Government assistance.

LITHIUM—Exact lithium consumption figures are hard to come by since nuclear energy and other defense uses are classified, but the non-defense uses are fairly well known. Out of a consumption of about 12,000,000 lb, lubricants take 35 percent; ceramics and glass, 27.8 percent; metallurgical and organics, 14.7 percent; storage batteries, 10.2 percent; air conditioners, 7.3 percent and welding and brazing, 5 percent. It is obvious that the market must be much larger; otherwise all of the companies in the business could not survive.

The American Lithium Institute

was established by American Potash and Chemical Corp., Foote Mineral Co. and the Lithium Corporation of America. A non-profit organization, it maintains offices at Princeton, N. J., with Marshall Sittig serving as managing director. In an article published in the *Journal of Commerce* in September, Sittig pointed out that the first research project established by the Institute is to be carried out at Pennsylvania State University on the use of lithium in glass. Since there are almost as many tons of glass made annually as steel, a minor proportion of lithium in all glasses would represent a major market for lithium chemicals. Its use in metallurgy is as an alloy. Alcoa has produced a lithium aluminum alloy which remains strong at 400°F. and lightens the weight of aircraft.

Sittig then discussed the separation of the isotope lithium 6 from lithium 7. The uses of lithium 6 remain classified, but lithium 7 has a low neutron cross section and hence it shows considerable promise as a coolant for nuclear reactors. Lithium 6 absorbs neutrons and produces tritium, and this factor could be the basis for the production of thermonuclear power.

Lithium's use as a catalyst is being studied at Princeton. Interest in it was disclosed by Firestone Tire & Rubber Co. which uses metallic lithium dispersed in petroleum jelly to make its "natural synthetic rubber from isoprene.

Another "glamour" field is in the high energy fuels. Lithium hydride is one chemical used in some processes to make B_2H_6 . Solid propellants are another possibility. Lithium perchlorate offers the highest percentage of available oxygen in all of the perchlorates and is in semi-commercial production.

A monograph on Lithium and its Compounds is in preparation for the American Chemical Society, as well as

a handbook being prepared for the Air Research and Development Command.

Footo Mineral Co. reported that it had a five-year contract with the Atomic Energy Commission to supply LiOH. Two other companies are also supplying the chemical. The AEC removes the lithium 6, and returns the "tails" to the manufacturer of the "virgin" LiOH. There is now more lithium available to industry than ever before because of the availability of these "tails."

A description of lithium deposits in Canada was given in the *Canadian Mining Journal* for April. Quebec Lithium reported a net income of \$880,749 for 1956. The company has a five-year contract with Lithium Corp. of America for a fixed tonnage of concentrates. It was announced in November that Quebec Lithium will build its own chemical plant at Rouses Point, N. Y.

Montgary Explorations, Ltd., was sinking a shaft at Bernic Lake, Mani-

4831 tons of lithium minerals in 1956, mostly of petalite, and most of the shipments went to Europe.

MAGNESITE—A tabulation of the world production of magnesite for the period 1947-56 shows that Austria, as usual, was the leading producer, with more than twice the production of the second country, the United States.

In Austria, the Astro-American Magnesite Co. of Radenthein, Carinthia is increasing its output by developing the deposit at Fieberbrunn, Salzburg Province. The mining and calcining of magnesite near Gabbs, Nev., was described in literature this year.

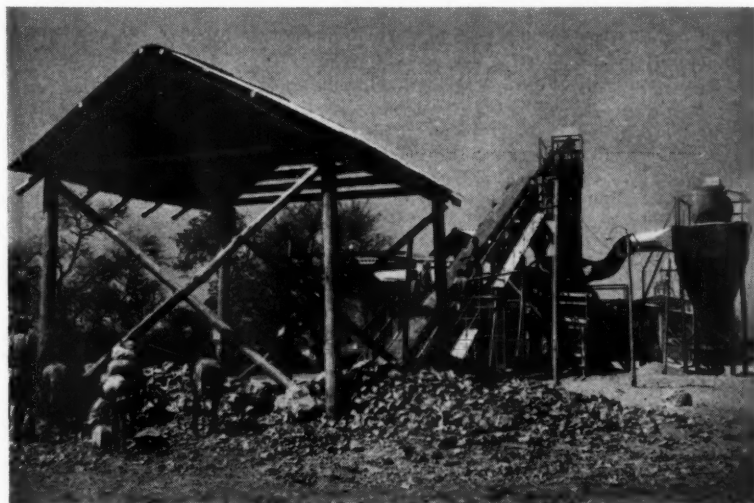
MICA—The U. S. mica purchasing depot at Spruce Pine, N. C., purchased mica to the value of \$3,000,000 in 1956 and expects that the total for 1957 will be 25 percent greater. Two big blocks were brought to the depot, one worth \$2006 and the other \$892. The General Services Administration announced in May that purchase of

The yield is still low, and the crystals have to be picked out of the cooled melt by hand. The process, described briefly, consists of heating sand, alumina, magnesia, potassium silico fluoride and an auxiliary source of potassium, such as feldspar, in an electric furnace to 1400° C. and holding it for hours at that temperature. The batch is then cooled slowly to room temperature. The resulting synthetic mica is a phlogopite. Usually there are only a few large crystals per batch. The remainder of the melt, mostly small crystals, is crushed, ground, mixed with glass, and molded into final shapes.

MONAZITE—Although many important deposits of monazite were being found in the world, there still seems to be no great market. A deposit near Dubois, Wyo., said to be 11½ miles long was being developed by the Little Jim Mining Co. The Northwest Prospecting and Development Co. of Spokane announced in December that it had shipped its first ton of monazite concentrates from its Hall Mountain property near Port Hill, in northern Idaho. There was no reported activity from the several placers in the Boise Basin of Idaho which, about two years ago, were shipping on a government contract. The potential of the alluvial deposits in the Pacific Northwest was analyzed in U. S. Bureau of Mines Information Circular 7767.

The first shipment of a thorite ore by Trail Mines from a mine on the Old Gold Camp Road near Cripple Creek, Colo., was also reported in December. The Heavy Minerals Co., owned by Crane Corp. and Vitro Corp., started its Chattanooga plant based on sands dredged in a delta deposit in Horse Creek, near its point of discharge into the Savannah River, near Augusta, Ga. The mineral produced there is monazite. The newly discovered ilmenite deposits in New Jersey and in western Tennessee also contain substantial quantities of monazite, which will be available when those deposits go into operation.

The process for treating rare earth ores by ion exchange by a process developed at the Ames (Iowa) Institute of Atomic Research by F. H. Spedding and J. E. Howell was described by Howard E. Kremers of the Lindsay Chemical Co. which is the largest producer of cerium, thorium and rare earth chemicals. After removing the cerium and thorium from the monazite, about a dozen of the rare earths are separated into compounds having a purity of 99.9 percent. An ion exchange process is also being tried out by Horizons, Inc., of Cleveland. Horizons claims it can also produce pure thorium metal by reacting thorium nitrate with sodium carbonate to make thorium oxycarbonate, which is turned to the oxide



Foreign operations, such as the vermiculite mine in Africa shown above, accounted for much of the world's production of industrial minerals

toba. American Metal Co. had an option on the property until November, but decided not to exercise it after a study of existing markets for lithium and its compounds.

Very large reserves are believed to occur in the Yellowknife area of the Northwest Territories where National Lithium owns 414 claims.

Bikita Minerals, Ltd., of Fort Victoria, Southern Rhodesia, put in a new picking plant to up-grade the product. This company ships to American Lithium Chemicals Co. of San Antonio. The Bikita deposits of lepidolite and petalite are large and among the richest in the world, containing 3.2 percent LiO₂ as compared with 1.3 to 2 percent for other producing areas. 78,192 tons were exported in 1956, of which 63,470 went to the United States. Southwest Africa exported

mica from foreign sources will be made on five-year contracts, instead of the former two to three-year pacts.

The Old Mike mica mine near Custer, S. D., was optioned by the Minnesota Mining and Manufacturing Co. In North Carolina, Kings Mountain Mica Co. completed a plant to produce scrap mica on Charlie Moss property where reserves ample for 25 years are claimed.

In New Mexico, near Taos there are four mica processing firms, the operation of one called Petaca Mining Co., was described in *Rock Products* in September. Columbium Milling and Mining Co. is preparing a mill site for a 100 tpd scrap mica plant.

The manufacture of synthetic mica by the Synthetic Mica Corp. was improved during the year. It now makes crystals 4 by 4 by ⅛-in. as routine.

by heating. This is chlorinated, and the chloride is electrolyzed to the metal.

Thorium has been found in many of the pyrochlore ores found in the so-called carbonatites. If and when these are worked for columbium, a large amount of thorium will seek a market. The presence of thorium is probably more of a deterrent than a help toward the development of these deposits, since the countries in which they occur impose restrictions on the production of a "fissionable" element.

Although the metals rubidium and cesium do not occur in monazite, mention of them may be made here. San Antonio Chemicals, which produces lithium chemicals from Rhodesian ore, finds it has these compounds available after removal of the lithium. A plant costing \$750,000 went on stream in March to recover mixed alkali carbonates from the alkali-rich end liquors of the lithium plant. The parent company, American Potash and Chemical Co., has started a research program on uses for the carbonates and the metals, and on how to isolate and reduce them.

Further in regard to cesium, a deposit of pollucite was found in the spodumene ore of the Montgar's lithium mine at Bernic Lake, Manitoba.

NITRATES—The production of nitrogen as ammonia, nitric acid and urea does not belong in an industrial mineral summary, although nitrogen in the air is certainly a mineral raw material. Producers of ammonia, and productive capacities, were listed in *Chemical Week* for January 12. Capacity for the year was estimated at nearly five million tons, of which 469,000 tons were due to 1957 additions, at 55 plants run by 41 companies. Of the ammonia, 76 percent goes into fertilizers. The 1957 nitric acid capacity was given in *Chemical Week* for July 6 and totaled 3,735,000 tons in 48 plants, run by 29 companies. Urea capacity is around 500,000 tons, made by nine companies. In spite of this large production of synthetic nitrogen, America continues to be a good customer of Chilean nitrate, having imported 473,116 metric tons in 1956.

The production of Chilean nitrate in 1956 was 1,158,437 metric tons, a reduction from the previous year of 25 percent due principally to a three-month strike at the Marie Elena and Pedro de Valdivia plants of Anglo-Lautaro which produce about 65 percent of all Chilean nitrate.

PERLITE—After a record production of 270,000 tons, valued at \$13,700,000 in 1956, the Perlite Institute expected sales of 300,000 tons valued at \$15,000,000 in 1957. Thirty companies have 84 plants in 19 states. An excellent review was given in the pages of *Mining Congress Journal* in September. Perlite is a volcanic glass containing three to eight per-



Expansion was the rule, rather than the exception, throughout the field. In the foreground, the new \$1,000,000 loader at the Freeport Sulphur Company's new shipping facilities on the Mississippi River at Port Sulphur, La., is shown filling inland waterway barges

cent water. Upon heating, the resulting steam expands the glass to an artificial pumice. Nearly all of the deposits worked are in California, Arizona, Nevada, New Mexico and Colorado. The most common furnace used is a horizontal rotary, with a concentric preheating shell surrounding the direct fired expanding tube. Three different stationary vertical furnaces have been accepted. These are used with or without a preheating tube. There are about 120 furnaces in operation in the U. S. and Canada with an hourly capacity of from 1 to 1½ tons each.

Perlite is used principally in plaster and in light-weight concrete blocks. Expanded perlite, with a bulk density of four lb per cu ft, is used as loose fill insulation. It is also valuable for its fireproofing qualities when used as a plaster on metal lath.

PUMICE—Figures for domestic production of pumice include volcanic cinders and scoria used as railroad and highway ballast. In 1956, out of a production of 1,482,214 tons, the coarser cinders and scoria accounted for 594,661 tons. The principal production of pumice and volcanic cinders in this country is in Oregon and California.

REFRATORIES—High temperature resistant fibers are most sought-after, since natural asbestos melts down to a glass at about 500° C.

There are several possibilities. The Carborundum Co. has its Fiberfrax which is an aluminum silicate glass, blown out as a fiber. It has now been produced in new textile forms includ-

ing roving, yarn, woven tape and in broad-woven fabrics.

Atomic Laboratories, of Berkeley, Calif., is offering in pilot plant quantities a carbon wool, described as a "dense fibrous form of pure carbon." The fibers are available in diameters of 5 to 50 microns.

A new fiber glass that does not soften when exposed for days to 2350° F and can also be made in foam form, has been produced at Rutgers University. Quartz has been drawn into fibers with the high tensile strength of 210,000 lbs psi, metal-coated and felted into a structural material by Bjorksten Research Laboratories.

A refractory cement has been developed by Charles Engelhard, Inc., called "CA-9." The material bonds to metal, glass or ceramics and will withstand temperatures up to 1000° F.

The Norton Co. is building a new refractories plant at Worcester, Mass., to cost \$1,500,000. It has also built a plant at Huntsville, Ala., with two electric furnaces to produce boron carbide, fused magnesium oxide, fused zirconia and fused alumina. Harbison Walker has announced a new research center on a 21-acre site south of Pittsburgh.

SALT—The U. S. Geological Survey published as its Bulletin 1019-J an annotated bibliography and index map of salt deposits in the United States. The world production of salt for the period 1947-56 is given in *Mineral Trade Notes* for August. In it 106 countries are listed as producing salt, headed by the U. S. with 24,225,000 tons for 1956, followed by the U.S.S.R.

with 7,200,000 tons and China with 6,600,000.

Salt Mining in Nova Scotia was described in the Bulletin of C.M.M. for December. The Malagash Salt Co., Ltd., is developing a new deposit as Pugwash in Cumberland County. The reserve is estimated at 200,000,000 tons.

The International Salt Co. has been granted a contract to mine salt under Lake Erie near Cleveland. A 2000-ft shaft will be sunk on Whiskey Island, and from there a drift will be driven to the salt. In an operation similar to that at Cleveland, the Dominion Salt Co. plans to sink an 1800-ft shaft at Goderich Harbor, Ontario, on the east shore of Lake Huron.

SILICA—The Canadian Silica Industry has been described in a new publication of the Mines Branch, called Memorandum Series No. 134.

The use of silicones in the ceramic field was described in the *Ceramic Bulletin* for June by an engineer in the Silicene Products Dept of the General Electric Co.

SLAG—An authoritative article on furnace slag as applied to its use in Portland Cement appeared in *Rock Products* for March, April and October. The Bureau of Public Roads published in its research journal an article with a mass of statistics on the increased use of blast furnace slag cement. A blast furnace slag cement is defined by the American Association of State Highway Officials as an intimately ground mixture of Type 1 portland cement clinker and granulated blast furnace slag. The slag content ranges from 25 to 65 percent of the final product. Because the slag does not have to be burned in the mill, the output of a cement plant can be increased without adding capacity. Blast furnace slag cements give higher strength at 90 days than comparable concrete containing only portland cement.

SODIUM SALTS—The Intermountain Chemical Company's trona mine and soda ash refinery near Rock Springs, Wyo., was expanded from a capacity of 350,000 tons to 400,000 tons. A third shaft was completed. The U. S. Geological Survey published Bulletin 1045-C giving logs from the drilling of Soda Lake, San Bernardino, Calif. Dow Chemical Co. is starting construction of a chemical distribution plant at Grants, N. M., to distribute caustic soda and soda ash to the uranium mining industry.

TALC, SOAPSTONE AND PYROPHYLLITE—Out of a world production of these minerals in 1956 of 1,830,000 tons, the U. S. produced 739,039.

Talc mining was started during the year in northern Pend Oreille County, Idaho, by the Southern California Mining Co.

TITANIUM — Titanium develop-

ments in the United States were numerous. First, the New Jersey deposits discovered by the New Jersey Geological Survey late in 1956, were very diligently prospected by a half dozen companies. The deposits occur mostly in Ocean County, and extend from the western boundary of the county near Prospertown southeastward beyond Lakehurst. They were described in a paper read before the Geological Society of America meeting at Atlantic City in November. Although irregular and variable in extent, depth and grade, the deposits are fairly consistent along the line of an old river channel. Near Lakehurst some of the accumulations have been found to persist to depths of 100 ft or so. At least one company has acquired substantial holdings near Lakehurst. Other companies withdrew when they found that land was being held at city-lot prices.

Another discovery that is probably of major importance is in Benton, Carroll and Henderson counties, just west of the Tennessee River in west central Tennessee. There a Cretaceous sediment called the McNary sand carries titanium minerals in places. The deposits, probably of marine origin, have been explored with some thoroughness by at least three companies.

A number of deposits in the mountain states have been found in Cretaceous sandstones, but they seem to be individually small. They have been found in Wyoming, Colorado, Utah, Montana and New Mexico. Probably one of the largest is that near the Indian Trading Post of Senostee, some 70 miles north of Gallup, N. M. All of these deposits are probably old stream channels of limited size. They were discovered by uranium prospectors with airborne radiometric equipment, who abandoned them when they found the radioactivity came only from small concentrations of monazite.

Metal and Thermit Corp. of New York, built a rutile and ilmenite concentrating plant at their deposit in Hanover County, Va., and placed it in operation late in the year.

Union Carbide Co. spent the year actively developing its deposit on Amelia Island, in the northeast corner of Florida. The deposit there is one of the numerous narrow elevated sand bars many of which occur on the mainland east of Yulee in the property of the Rayonier Paper Co. Although this deposit, like most of those in Florida, is about 85 percent ilmenite and 15 percent rutile, the research chemists of the company have developed a process for using the ilmenite in the manufacture of $TiCl_4$, which is the starting compound for titanium sponge. Most of the sponge manufacturers use rutile. With the slump in the metal business, construction on

Amelia Island is said to have been slowed down.

Just north across the mouth of the St. Mary's River, and off the Georgia Coast is Cumberland Island. A deposit on this island has been leased by the Glidden Co. This is probably another one of the old sand bars in the same group of Amelia Island and Yulee. The Glidden Co. entered into a lease for 7,000 acres of ore lands on Cumberland Island. However, the status of this lease is now being litigated. If the lease is upheld the company expects a 15 to 20 year supply of raw material.

In Florida there were no important new developments in the operating plants at Starke, Lawtey and east of Jacksonville. At Vero Beach, however, Hobart Brothers installed a new bucket dredge. At Panama City, Heavy Minerals Co. started a plant to concentrate the heavy minerals on the beaches, and at the same time was continuing its dredging operations on Horse Creek, near Aiken, S. C.

Continuing with news of sand deposits, there was much activity abroad. In South Africa work was started on the coast of Natal south of Durban at a place called Umgababa, by the Anglo-American Corp. In Liberia, and Sierra Leone, on the west coast of Africa deposits were under development by Columbia Southern Co. and by British Titan Products Co. Development of the Ceylon deposits was proceeding with difficulty, but the Japanese firm of Ishara had offered to option the entire output, as and when produced. At first, in eastern Australia, where most of the world's supply of rutile has been produced, activities were hectic. First, there was pressure to increase production, but then, after the collapse of the rutile market, the slump was very severe. The number of rutile producers rose within one year from 13 to 29 (there had been 8 in 1955), but when the price dropped to below \$90 per ton, most of the new producers had to shut down.

In western Australia there was also rather intense activity. Two companies are exporting ilmenite and making additions to plant, while a third is expected to come into production in 1958. The ilmenite bearing areas in the vicinity of Bunbury, south of Perth, are extensive. Ilmenite is the principal titanium mineral, and it is almost free of chromium. This is in contrast to the high ilmenite in the Queensland and New South Wales sands. Rutile and monazite are low, but considerable zircon is present. Western Titanium is the largest producer with a capacity of 3000 tons of ilmenite per month at its plant at Capel. Most of the output has been sold to Japan.

News about the producers of titanium
(Continued on page 136)



Construction of this surface plant of Potash Company of America began on June 1 and will be completed late in 1958

Potash in 1957

Upward trend in both productive capacity and consumption of potash prevailed through the year. Build-up of inventory by year's end is considered temporary, and exploration activity continues at a fast pace

PRODUCTION and deliveries of potash will set a new record in 1957 based upon the latest figures available from the American Potash Institute and from individual companies.

The North American potash industry currently comprises eight producing companies, six operating underground mines in the Permian salt deposits near Carlsbad, N. M.; one producing from brines in the crystalline salt mass of Searles Lake, Calif.; and one producing by solar evaporation from the Salduro Marsh near Wendover, Utah.

Growth Continues

A review of the latest statistics published by the American Potash Institute shows a continual rise in deliveries for the industry. For the first nine months of 1957 the eight North American producers plus importers reported deliveries nine percent greater than those reported for the corresponding period in 1956. Potash for agricultural use in the United States, Canada, Puerto Rico, and Hawaii was over five percent greater than the corresponding period in 1956. Potash consumed by domestic chemical consumers decreased for the first time by four percent. However, exports by domestic producers to markets outside North America increased 71 percent over the previous year's record.

During this period, however, production capacity of the domestic industry temporarily exceeded demand and finished product inventories in producers' warehouses reached an all-time high at year's end.

Should the indicated trend in deliveries experienced in the first nine months obtain, total deliveries for the year will be a record 2,450,000 short tons K_2O , resulting in an increase of six percent over the previous record year 1956.

Production by North American underground producers was at an estimated 11,000,000 tons of crude ore with the total tonnage of finished production by the industry's eight producers estimated at 2,300,000 short tons K_2O .

Potash as a major industry on the North American continent had its beginning in 1931, and its phenomenal growth is best demonstrated in tabular form.

Year	Production Short Tons K_2O
1930	61,269
1940	379,673
1950	1,287,740
1955	2,080,311
1956	2,171,584
1957 (est.)	2,300,000

While Canada continued to headline exploration and development in

By C. A. AREND, JR.
General Manager, Potash Division
International Minerals & Chemical Corp.

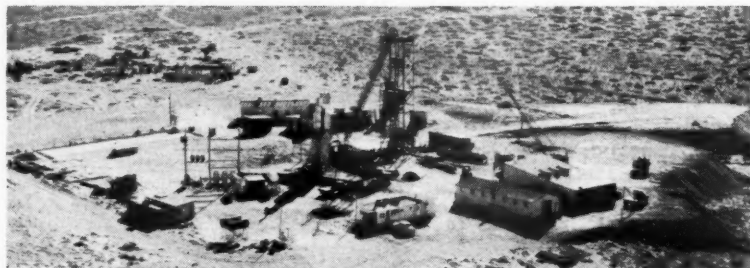
Carl A. Arend, Jr., a graduate chemical engineer, joined International Minerals and Chemical Corp. in 1945 after distinguished World War II service as an officer in the Ordnance Dept. He served IMC first at the Columbia Park, Ohio, chemical plant, where he became superintendent, and was later transferred to the Carlsbad, N. M., potash mine and chemical plant where he worked up to the position of manager. Since 1955 Arend has been general manager of his company's Potash Division.



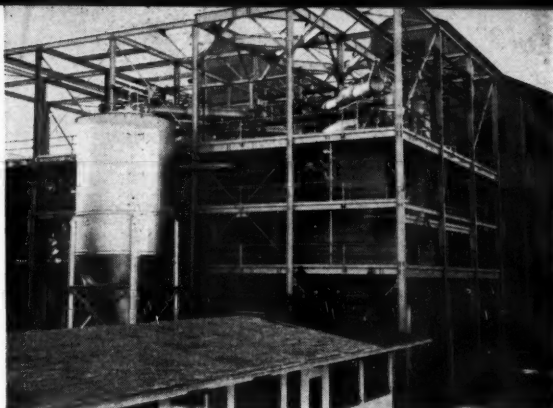
1957, activity in the United States continued with Delhi-Taylor reporting the discovery of over 100,000,000 tons of ore southwest of Moab, Utah. National Potash Co., the eighth domestic producer, went on stream as scheduled in January, 1957; and by the end of the year Farm Chemical Resources Development Corp. had completed its first shaft in New Mexico. The United States Department of the Interior, Bureau of Land Management, offered for public sale the potash-bearing lands it formerly held in New Mexico as a Federal Reserve. National Potash Co. was the successful bidder at a price of \$1,867,340.

Large Reserves in Saskatchewan

In the face of much publicity concerning temporary overproduction by existing producers, Canada was the scene of record activity. Saskatchewan's border-to-border potash belt, which stretches across the south-central part of the province, attracted many of the world's leading producers, including French, British, German, Canadian, and American inter-



1957 saw the completion of the first shaft of Farm Chemical Resources Development Corp. in Lea County, N. M.



Seven Struthers-Wells crystallizers have recently been installed in this United States Potash Co. plant to produce a coarse muriate product of various specified sizes

est. Eighteen companies and at least four individuals were reported by the Department of Mineral Resources to hold under disposition a total of 2,874,495 acres. Of the total acreage involved, as of July, 12,576 acres were under lease, 87,300 acres were held under reservation, permits accounted for 934,163 acres, and the remaining 1,840,456 acres were held under withdrawal.

According to some estimates, the potash-bearing salt beds of Saskatchewan's Prairie Evaporites contain as much as 30 billion tons of potash above the 4,000-foot horizon. The estimates for ore of better than 25 percent K_2O of mineable thickness at depths less than 4,000 feet are five billion tons.

Year's Activities of the Potash Producing Companies

American Potash & Chemical Co.'s major plant changes during 1957 included the doubling of coarse muriate of potash production at its Trona, Calif. plant. The project cost approximately \$750,000 and was part of the company's \$3,500,000 1957 improvement program. Construction of the new coarse muriate unit was completed in two parts, with the first half completed in mid-year and the final phase put on stream in December. In addition to these basic production units, new screening equipment was installed to enable the company to produce a more uniform coarse muriate product with fewer fines and oversize particles.

Sales executives of American Potash & Chemical Co. believe that there will be an annual increase in the consumption of potash salt in the Pacific area of approximately five percent for the next several years.

Bonnieville, Ltd. at Wendover, Utah reports no changes in basic plant or process during the past year. Bonnieville recovers the potash values from salts recrystallized by solar evaporation. The flotation plant has a capacity of 1200 tpd of crude salt feed.

Duval Sulphur & Potash Co. reported mining operations continued with production on a three-shift basis during the entire year. A rubber-

mounted universal type undercutter was added to the mine production equipment during 1957.

While no significant changes were reported in beneficiation techniques in the refinery, substantial changes were made in the physical sizing of finished production. Because of increased demand for coarse muriates, a compaction plant was constructed during the year.

In this section of the plant, the finer fractions of potash are compacted in roll compactors, producing hard thin flakes of material which are subsequently crushed and screened to the desired size.

Farm Chemical Resources Development Corp., a joint venture of National Farmers Union, Kerr-McGee Oil Industries, Inc. and Phillips Petroleum Co., completed their first shaft during 1957. Operations are currently scheduled for late 1960.

International Minerals & Chemical Corp. The principal emphasis underground was in the area of mining efficiencies. Rope belt conveyers were installed on the 850-ft langbeinite level, replacing the trolley shuttle car for main line and panel haulage.

The first rope belt was installed experimentally at a length of 500 ft. and is now operating at well over 2,000 ft. A second transverse belt, discharging onto the main belt, has recently been installed to mine areas nearer the fringes of the ore deposit. The rope belt has proven very successful for this type of application, substantially increasing haulage efficiency and tonnage moved.

Conversion of auxiliary mining

equipment, such as powder cars, grease wagons, and man-trip vehicles, to the use of diesel power with maximum maneuverability and speed was continued throughout the year.

On the 900-ft level, gathering haulage in the panels was improved by the application of track-type car movers to a continuous loop haulage system.

In the refinery, a completely new product screening and sizing plant was installed to satisfy the market demand for increased amounts of coarse muriate of potash and improved standard grades.

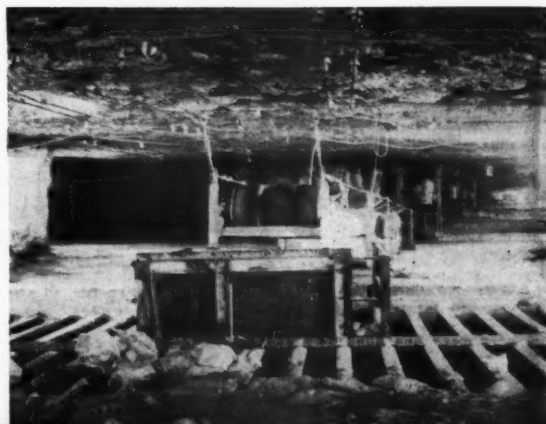
During 1957 the plant's 18-mile water supply line was completely cleaned and coated with an Epoxy Resin in order to improve flow characteristics and lengthen the life of the pipeline. This work was carried out without interruption of water flow by the use of aluminum bypass pipelines and a three-way Stopple system which permitted the diversion of water through a 12,500 ft. bypass section during the cleaning and coating operations.

On May 14, 1957, IMC announced plans to start immediately sinking a shaft for a new potash mine near Esterhazy, Saskatchewan, Canada. The contract for construction of the mine shaft and several surface structures has been let to Utah Construction Co.; and by the end of the year, the 18-ft circular shaft had been successfully completed through the glacial till. Freezing of this first 325-ft of water-bearing strata enabled sinking to proceed without incident.

National Potash Co. completed shaft construction and mining started about January 1, 1957, using two continuous miners to develop around the shaft bottom, providing the initial entry system into the main ore body and to establish ventilation. Upon completion of the development work, the continuous miners were removed, and conventional equipment was placed in production service. Rope belt conveyors were used to convey the ore to the shaft bottoms for crushing and hoisting.

National Potash Co. has two 15-ft diameter concrete-lined circular shafts in a common shaft pillar. Both men and ore hoists employ the Koepe multi-rope friction system. This is the first application of this system in the Permian Basin.

Rope belt conveyors were installed underground by International Minerals and Chemical Corp., replacing the trolley shuttle car for main line and panel haulage



Surface plant construction was completed in January, and refining operations started on January 30, 1957. The conventional flotation method of beneficiation is employed. Low temperature vacuum crystallization is used to recover fine potash values liberated in the ore de-sliming section. Throughout 1957 production has been maintained at 50 to 66 percent of designed capacity and further construction has been started to increase capacity for the production of the coarse grade of product.

Potash Company of America. During 1957, Potash Company of America made substantial revisions and additions to its surface facilities. A flotation unit to produce a coarse grade of muriate of potash was completed in August; and a second facility was placed in operation in September, utilizing compactors to compress fine crystalline muriate into a hard flake preparatory to crushing and sizing to meet coarse muriate specifications.

About midyear the planned transition of all mining to continuous mining machines was completed. At the present time a substantial part of the mine production is conveyed from the working face directly to the main hoisting shaft entirely by belt conveyors.

Engineering and construction of a larger and more powerful PCA continuous miner was completed, and production tests were under way late in the year.

At its Canadian potash project, 14 miles east of Saskatoon, Saskatchewan, shaft sinking operations continued throughout the year with 2400 ft of shaft completed to date. On June 1, construction of the surface plant was started. It is scheduled for completion late in 1958.

Southwest Potash Co. Maintaining product quality continued to be a primary objective at Southwest Potash Co. during 1957, and full utilization of extensive plant modifications completed during the previous year were realized. A one-unit compaction plant was started late in the year to increase the production of coarse muriates.

Underground Southwest Potash Co. obtained substantial tonnages of ore from secondary mining areas where highly satisfactory extraction of pillars is being achieved. Over-all mine production was facilitated by the addition of a 15-RU Universal Undercutter and a Super 14-BU loader.

United States Potash Co., Division of United States Borax and Chemical

Corp., completed the installation of mining facilities at its shaft No. 3, located six miles north of the main shaft. An outstanding feature of the new mining area will be the complete lack of underground railways. Operating plans call for exclusive use of continuous miners and extensible belts. Ore hoisted from this shaft will be transported over the recently completed ore-haulage road to No. 1 shaft for transport by company-owned railroad to its refinery near Loving, N.M. Overland ore transport equipment is custom-built Kenworth tractors powered with 335-hp Cummings turbo-supercharged diesel engines coupled to 37½-ft long Timpte Brothers trailers of 50 tons capacity. The tractor unit has 16 forward and 3 reverse speeds, hydraulic powered steering and refrigerated air conditioned cabs.

At its refining operations United States Potash Co. completed a \$2,500,000 construction program for the production of high-grade coarse muriate of potash. The principal equipment installed was seven Struthers-Wells crystallizers, which will be fed with regular mother liquor from the dissolver plant and will produce a coarse muriate product of various specified sizes.

Phosphate

By **SIDNEY T. KEEL**

Sales Manager, Phosphate Minerals Div.
International Minerals & Chemical Corp.



Sidney T. Keel has been close to the phosphate operations of International Minerals and Chemical Corp. from the time of his birth—his father was a longtime employee of the company at its Florida operations. Sidney received a civil engineering degree from Clemson College in 1940 and first went to work at the company's Tennessee operations where he became assistant mine superintendent. His career was interrupted by five years of U. S. Army service during World War II. He was released from duty as a Major in Ordnance in 1946, after spending three of his service years in India. Keel has worked in Phosphate sales ever since, and currently, as Manager of Sales of the Phosphate Minerals Div., he directs both domestic and export sales of phosphate products for his company.

The year 1957 was marked by a trend toward more efficient operation by the 15 companies producing phosphate rock in three major districts of the United States

THE estimated marketable production of phosphate rock in the U. S. during this past year was 15,000,000 long tons compared to 15,700,000 in 1956.

By areas, the quantities mined were: Florida—11,200,000 tons; the Western field—2,280,000 tons, and Tennessee—1,520,000 tons.

The Florida Land Pebble Phosphate Field in central Florida has eight active producers who operate in the Lakeland, Bartow and Mulberry area. Further north in the area near Ocala is the hard rock section which produces about 100,000 tons annually for electric furnace feed. The Florida tonnage is consumed almost entirely in the fertilizer industry for the manufacture of superphosphate, triple superphosphate and other phosphatic fertilizers. The nature of the product readily lends itself to grinding and acidulation with sulphuric, phosphoric or nitric acid. The grade produced analyzes as high as 36 per cent P_2O_5 as compared to 33 per cent in the

western deposits and about 31 per cent in Tennessee.

The Western field continued its growth with some new construction and about a 5 per cent increase in production.

Tennessee, hampered by exhaustion of its high grade reserves, suffered a 10 per cent reduction in the tonnage produced this year over the previous year.

The world production of phosphate rock is now slightly more than 30,000,000 tons which makes the United States participation about 50 per cent of the total.

Operations Reviewed by Companies

American Agricultural Chemical Co. is a large fertilizer and chemical manufacturer. Operations for the year remained about normal but the company has on order a Bucyrus Erie 770B dragline with a 20-cu yd bucket and a 195-ft boom. This will be delivered later in 1958 and will go in operation the following year.

American Cyanamid Co. The new Orange Park Mine located north of Lakeland was placed in operation in June. This property replaces the mined out Saddle Creek mine south of Lakeland. In July the new triple superphosphate plant at Brewster went into operation with a reported capacity of about 600 tpd.

Armour Fertilizer Works is probably the largest manufacturer of fertilizer in the United States and the newest miner in the field, whose plant is still only about two years old. No additions or replacements have been made to the company's operations during the past year, and none have been announced for the coming year. Plans are being made to furnish phosphate slimes, in the near future, for the production of lightweight aggregate for concrete.

Coronet Phosphate Co. is a division of Smith-Douglas Co., a large manufacturer of fertilizer. During 1957 this company replaced a 150-ft Hydro Separator at the Tenoroc plant, northeast of Lakeland with 24-in. Dorr-clone for more efficient operation.

Swift & Co., also an operator of several fertilizer plants, is now completing the assembly of a Bucyrus Erie 500-W walking dragline which will go in operation early in 1958. This machine has a 14-cu yd bucket and a 175-ft boom and will be operated at the Watson mine just south of Ft. Meade. During the past year Swift & Co. installed a safety feature fertilizer use. The balance was common its electrical system, completed a remote control arrangement on its lift pumps, and through greater efficiency increased the capacity of its Raymond Pulverizers.

Virginia Carolina Chemical Co. also operates fertilizer plants throughout the eastern half of this country. No major additions to the company's plant or mine were made this year. However, in March shipments of fluoride wastes were started from the triple superphosphate plant at Nichols to Kaiser Aluminum and Chemical Company's new plant at Mulberry, Fla. The Kaiser plant converts the waste into sodium-silico-fluoride which is used to recover cryolite, an essential in the production of aluminum, at the New Orleans reduction plant.

Davison Chemical Co. also has several large fertilizer plants in the east and midwest. In March, 1957 this company dedicated a new and modern 8000-sq ft office building near Bartow, Fla., adjacent to a triple superphosphate plant and the Ridgewood mine. At the Standard mine matrix is now being pumped hydraulically a distance of 24,000 ft to the Pauway #4 plant without a relay well.

International Minerals & Chemical Corp. in addition to being miners of phosphate rock are also producers of potash in Carlsbad. The company



The most modern equipment and methods were used to produce 15,000,000 tons of phosphate rock last year

mines industrial minerals in several states and operates several fertilizer plants in the south and midwest. At the Bonnie plant near Bartow, Fla., a new sulphuric acid plant went into operation in June, 1957, which doubled acid production for the manufacture of triple superphosphate and animal feed additives. Steps have been taken to rehabilitate and expand the Noralyn washer for more efficient future operation. Work has also continued toward improving recovery in the beneficiation process. A contract has recently been negotiated with Kaiser Aluminum for fluoride waste material.

Trend to Lower Grade

While there are still many years left of Florida high grade reserves, at the present rate of mining, a trend to the lower grades of phosphate rock is noticeable. The demand for grades between 68 and 72 percent BPL rock is brought about by its use in the manufacture of triple superphosphate and the wet process of phosphoric acid. There are now nine large plants of this type in Florida alone with a total product capacity of 1,500,000 net tons annually. This concentrated high grade product is becoming more and more popular, especially in mid-western agriculture where the use of high analysis fertilizers is growing at a fast rate. This lessens the demand for normal superphosphate which for the most part uses a higher grade of phosphate rock.

Activities in the West

In the area known as the western field about 2,550,000 short tons of phosphate rock was mined in the states of Montana, Idaho, Utah and

Wyoming this past year reflecting an increase of about 5 percent over the corresponding year of 1956. About 1,100,000 tons of this production was up-graded and most of this was for sumed in electric furnace manufacture of elemental phosphorus.

Montana Phosphate Products Co. maintained production at the Anderson mine throughout the year and continued driving an 11,000-ft. cross-cut some two miles south of the Anderson shaft near Garrison, Mont.

Victor Chemical Works mined and washed ore from its Maiden Rock and Canyon Creek mines for use at the Silver Bow furnaces in the manufacture of elemental phosphorus.

J. R. Simplot Co. confined operations of the Gay mine near Pocatello, Idaho, to the summer months only. The high grade produced is used in the company's fertilizer plant at Pocatello and the low grade shales are shipped to the nearby plant of Westvaco Mineral Products for furnace feed.

At Simplot's Centennial mine located on the Montana-Idaho border near Monida, summer operations continued and the phosphate rock produced was shipped to Canada for fertilizer use.

The Anaconda Co. again operated its new surface mine at Conda, Idaho, during the past summer after closing down its underground mine in 1956. The new property produces some high grade, but the ore is principally a low grade shale which is beneficiated at Conda for use in the triple superphosphate plant at Anaconda, Mont.

The San Francisco Chemical Co. operated its Waterloo mine at Montpelier, Idaho, in a limited way. In October a new beneficiation plant to up-grade the rock from their Leefe, Wyo. mine went into operation. The Arikaree underground mine continued operations in the Crawford Mountain area just south of Leefe. Also in this same area a cross-cut tunnel was driven to go under two older mines intersecting both limbs of the syncline. Prospecting operations are being carried on by San Francisco and Stauffer Chemical Companies, thirteen miles north of Vernal, Utah, on the extensive low grade property known as the Humphrey deposit.

Monsanto Chemical Co. continued operation of the Ballard mine sixteen miles north of Soda Springs, Idaho, during the summer months only for its electric furnace feed.

Central Farmers Fertilizer Co., mid-west cooperative, started construction of its new electric furnace plant near Georgetown, Idaho. The company built ten miles of railroad up the canyon in addition to new power lines to the plant site. The end product of this plant will be calcium metaphosphate. It is expected that this material will be shipped largely to the

(Continued on page 124)

Sulphur Supplies Increase

The industry faces 1958 with a lower price tag on its product and increased competition among producers

By E. WICK EDDY

Research Department
Texas Gulf Sulphur Co.

E. Wick Eddy certainly rates the title of expert when his knowledge of the sulphur industry is considered. He has devoted his career to market research at Texas Gulf Sulphur Co. and has accrued 29 years of experience in that field.



THE year 1957 found the world sulphur markets using substantial amounts from many new sources. Table I compares 1957, a year of ample supply, with 1951 when sulphur was short. Much of the Mexican production and nearly all of the sulphur produced from hydrogen sulphide taken out of sour natural gas or from petroleum refinery operations was consumed in the United States. Australia, Canada and the U.S. have all contributed larger amounts of sulphur from copper and zinc smelter operations. The other forms of sulphur are made up of anhydrite, petroleum sludge, spent oxide, and hydrogen sulphide and liquid sulphur dioxide. In India and the United Kingdom, large amounts of anhydrite, calcium sulphate are converted to ammonia sulphate and sulphuric acid is also made from anhydrite in United Kingdom. It is estimated that over four times the amount of sludge was reconstituted into new sulphuric acid in 1957 when compared with 1951.

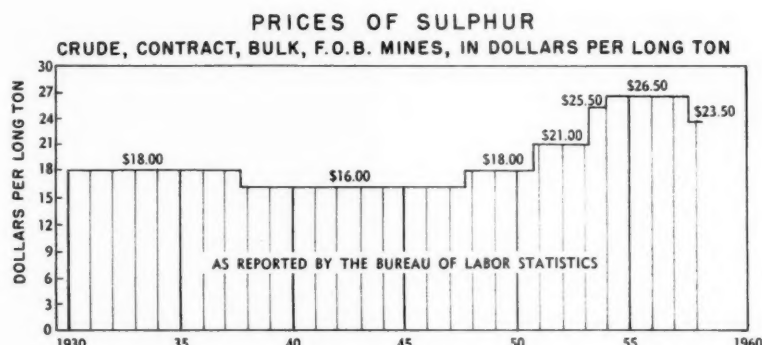


TABLE I
ESTIMATED WORLD SULPHUR CONSUMPTION

	1951		1957	
	1,000 L.T.	%	1,000 L.T.	%
Frasch Process—U.S.	5,095	44	5,100	33
Frasch Process—Mexico	0	—	900	6
Recovered Sulphur—U.S.	194	2	500	3
Recovered Sulphur—Canada	0	—	90	1
Recovered Sulphur—Others	76	1	215	1
Sulphur from ores	600	5	875	6
SULPHUR	5,965	52	7,680	50
Pyrites (sulphur equivalent)	4,500	39	5,500	36
Smelter gases (sulphur equivalent)	725	6	1,175	8
Other forms* (sulphur equivalent)	300	3	1,025	6
TOTAL	11,490	100	15,380	100

* For type see first paragraph of text

TABLE II
WORLD SULPHUR PRODUCTION

Frasch Process, Recovered from Hydrogen Sulphide, Produced from Sulphur Ores and Sulphide Ores

	Long Tons				
COUNTRY	1952	1953	1954	1955	1956
Argentina	15,000	16,000	17,000	17,651	23,038
Bolivia	5,497	2,458	2,565	3,975	3,418
Canada	3,773	14,352	16,667	35,980	44,222
Chile	47,821	32,275	39,075	54,132	45,000
Colombia	2,974	2,657	5,118	5,413	4,921
Egypt	2,800	3,250	3,640	4,000	3,000
France	17,692	10,710	—	2,850	5,000
Germany	51,100	59,600	67,800	70,800	77,110
Greece	—	1,200	2,507	3,600	3,600
Italy	232,706	224,161	200,215	179,755	170,094
Iran, Iraq	6,000	6,000	6,000	6,000	10,000
Japan	176,652	186,556	184,745	199,676	243,312
Mexico	48,284	33,488	79,221	495,549	784,138
Netherlands	3,000	11,713	9,252	6,900	12,000
Netherlands, Antilles	3,800	11,900	15,000	20,000	20,000
Norway	103,111	101,682	99,066	98,839	95,423
Peru	5,066	4,916	5,000	2,000	2,000
Portugal	15,627	16,340	16,100	15,426	16,879
Spain	38,800	38,545	40,400	38,388	50,900
Sweden	16,163	23,426	27,274	28,434	30,342
Taiwan	5,001	3,423	5,873	4,854	7,864
Trinidad	1,600	3,000	4,300	5,000	5,000
Turkey	8,232	9,626	9,862	11,318	3,722
United Kingdom	14,800	25,300	40,850	45,850	53,000
United States	5,546,540	5,535,259	5,938,244	6,198,660	6,949,043
GRAND TOTAL	6,372,039	6,377,837	6,835,774	7,555,050	8,663,026

Active Production

Sulphur in the form of brimstone is being produced by four different processes — Frasch method, recovery from hydrogen sulphide, production from sulphur ores, and production from sulphide ores. World production for each process and total are shown in Table II through VI. Some major changes in sulphur production occurred in 1957. In Canada, recovered sulphur production jumped from 29,222 long tons to about 100,000. The

plant of the British American Oil Co. at Pincher Creek came into production in February, the plant of the Laurentide Sulphur and Chemical Co. at Montreal started in the fall, and the plant of the Jefferson Lake Sulphur Co. at Peace River, B. C. also started production later in the year. In France, new recovered production started in May at a rate of 55,000 long tons annually. Frasch process production in Mexico increased from 753,415 long tons to over 1,000,000,

TABLE III
WORLD FRASCH PROCESS SULPHUR PRODUCTION
Long Tons as Reported by U.S. Bureau of Mines

COUNTRY	1952	1953	1954	1955	1956
Mexico	—	—	47,407	470,487	753,415
United States	5,293,145	5,155,342	5,514,640	5,738,978	6,423,883
TOTAL	5,293,145	5,155,342	5,562,047	6,209,465	7,177,298

TABLE IV
WORLD RECOVERED SULPHUR PRODUCTION
Long Tons; Trade & Government Sources

COUNTRY	1952	1953	1954	1955	1956
Canada (b)	3,773	14,352	16,667	25,980	29,222
Egypt (d)	2,800	3,250	3,640	4,000*	3,000*
France	—	—	—	2,850	5,000*
Germany	51,100	59,600	67,800	70,800	77,110
Iran, Iraq	6,000*	6,000*	6,000*	6,000*	10,000*
Mexico	36,500	27,588	26,814	20,062	25,723
Netherlands	3,000	11,713	9,252	6,900	12,000*
Netherlands, Antilles	3,800	11,900	15,000*	20,000*	20,000*
Sweden (c)	16,163	23,426	27,274	28,434	30,342
Trinidad	1,600	3,000*	4,300	5,000*	5,000*
United Kingdom	14,800	25,300	40,850	45,850	53,000
United States (a)	251,198	341,660	359,271	398,780	464,758
TOTAL	390,734	527,789	576,868	634,656	735,155

* —Estimated

(a)—Reported by U.S. Bureau of Mines

(b)—Reported by Alberta Pet. and Nat. Gas Conservation Board

(c)—Svenska Skifferoye A/B (Kvarntorp)

(d)—1952 International Materials Conference

TABLE V
WORLD PRODUCTION OF SULPHUR FROM SULPHUR ORES
Long Tons as Reported by U.S. Bureau of Mines

COUNTRY	1952	1953	1954	1955	1956
Argentina	15,000	16,000	17,000	17,651	23,038
Bolivia	5,497	2,458	2,565	3,975	3,418
Chile	47,821	32,275	39,075	54,132	45,000*
Colombia	2,974	2,657	5,118	5,413	4,921
France	17,692	10,710	—	—	—
Greece	—	1,200	2,507	3,600	3,600
Italy	232,706	224,161	200,215	179,755	170,094
Japan	176,652	186,556	184,745	199,676	243,312
Mexico	11,784	5,900	5,000*	5,000*	5,000*
Peru	5,066	4,916	5,000*	2,000*	2,000*
Spain	4,800	5,100	5,400	6,500	5,900
Taiwan	5,001	3,423	5,873	4,854	7,864
Turkey	8,232	9,626	9,862	11,318	3,722
United States	2,197	38,257	64,333	60,902	60,402
TOTAL	535,422	543,239	546,693	554,776	578,271

* —Estimated

TABLE VI
WORLD PRODUCTION OF SULPHUR FROM SULPHIDE ORES
Long Tons

COUNTRY	1952	1953	1954	1955	1956
Canada	—	—	—	10,000*	15,000*
Norway (a)	103,111	101,682	99,066	98,839	95,423
Portugal (b)	15,627	16,340	16,100	15,426	16,879
Spain (c)	34,000	33,445	35,000*	31,888	45,000*
TOTAL	152,738	151,467	150,166	156,153	172,302

* —Estimated

(a)—Mineral Trade Notes, U.S. Bureau of Mines

(b)—Annual Reports, Mason & Barry, Ltd.

(c)—Boletín de Estadística

and United States Frasch process production decreased from 6,423,883 long tons to 5,500,000 long tons. World production is estimated to have dropped from 8,658,000 long tons in 1956 to about 8,100,000 in 1957.

Frasch production in the United States in 1957 came from the same mines producing in 1956. Standard Sulphur Co. at Damon Mound terminated production in April, 1957. Duval Sulphur & Potash Co. continued to operate its Orchard Dome. Freeport Sulphur Co. produced from mines at Grande Ecaille, Garden

Island Bay, Bay Ste Elaine, and Chacahoula, all in Louisiana. Jefferson Lake Sulphur Co. produced at Clemens and Long Point in Texas and at Stark, La.; Texas Gulf Sulphur Co. produced at Boling Dome, Moss Bluff, and Spindletop, all in Texas, and completed construction of a new plant at Fannett Dome, Jefferson County, Texas, designed to heat two million gallons of water a day. This plant is approximately half the size of the Moss Bluff or Spindletop plants. Production will start early in 1958. A large recovery plant was put

on stream at Delaware City in May by the Tidewater Oil Co.

Texas Gulf is also starting to construct, early in 1958, a large recovery plant at Okotoks, Alberta, Canada, to recover sulphur from sour natural gas. A pilot plant to produce sulphur from the stack gases is being built jointly with International Nickel Co. at the latter's plant at Sudbury, Ontario.

Freeport Sulphur has announced that it will start construction of its offshore Frasch sulphur plant at the Grand Island dome acquired from the Humble Oil Co.

Although mines are producing in swampy locations this will be the first to operate in about 40 ft of seawater.

Price Reduced \$3/Ton

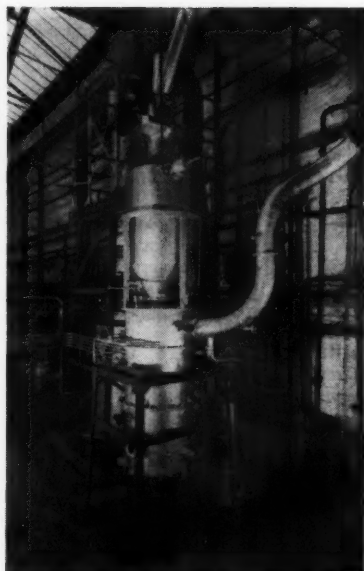
On September 17, 1957 Texas Gulf Sulphur Co. announced that because of competitive conditions it had reduced its price for sulphur by three dollars a long ton, and other producers followed immediately with similar changes. Chart A shows the reported prices of United States sulphur from 1929 to date.

In Europe, pyrites has been, and continues to be, the main source of sulphur. Lower pyrites prices in June 1957, coupled with lower ocean freight rates, had improved the competitive position of this oldest of all sources of sulphur. The three-dollar lower sulphur price brings sulphur into a closer relationship with the lower pyrites costs.

Historically the cost of producing sulphuric acid from pyrites has dictated the price of Frasch sulphur. In order to sell, Frasch sulphur must be priced competitively with the cost of sulphur in pyrites, but this price cannot be so low that it attracts a larger share of the market than it can supply. An example of this delicate balance between price and tonnage occurred in the 1949-51 period when Frasch sulphur producers selling in the \$18.00 to \$21.00 range were unable to supply the large demand attracted by that price.

More Adequate Inventories

Perhaps the most favorable development in 1957 was the buildup to a safer operating level of Frasch sulphur inventories above ground. Back in December 31, 1942 Frasch process inventories above ground totaled 5,114,484 long tons, representing twenty months' supply at the rate of apparent sales in 1942. By the end of 1950 these inventories had been reduced to 2,654,530 long tons or less than six months' supply at the 1950 rate of sales. By the end of 1957 inventories had been built back to 4,400,000 long tons, equal to ten months' current sales. Large inventories are important for national defense and protection against natural disasters.



Pilot scale cyclone slugging gasifier for fine coal at Britain's Fuel Research Station

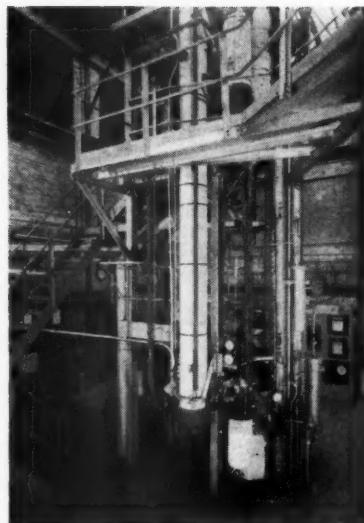
Coal Research In 1957

World-wide efforts directed toward developing better and more economical ways to mine, prepare and use coal

By HARLAN W. NELSON
Consultant, Department of Economics

and

RICHARD B. ENGBAHL
Division Chief, Fuels and Air Pollution,
Battelle Memorial Institute



A 50 gal per day pilot plant for synthesis of hydrocarbons by slurry process at Britain's Fuel Research Station

RESearch on coal appeared to have been carried on in this country at much the same rate of effort as during the past two years, although a few activities involving carbonization and coal chemicals seemed to be receiving somewhat increased attention. There was renewed sentiment, however, that the present research effort is inadequate for the development of the new coal-based processes, mechanized mining systems and the improved applications that many fuel technologists believe will be necessary for realization of coal's potential in the future.

Early in 1957 a Special Subcommittee on Coal Research was reauthorized by the House Committee on Interior and Insular Affairs, and the group at once began a series of hearings in coal-producing areas of the country. As a result of a report of this subcommittee made in August 1957, a number of bills were introduced in both the House and the Senate to accomplish the recommendations made. Chief of these was the establishment of an independent agency, a Coal Research and Development Commission, which would administer and coordinate an accelerated research program for the coal industry. Emphasis would be placed on promising research that might quickly develop new outlets for coal, but more difficult, long-range studies would also be scheduled. Other bills

were introduced to Congress to raise the tax depletion allowances for coal from 10 percent to 27½ percent, which is the present allowance for the oil industry.

Action on these bills will not be taken until Congress again convenes in 1958. However, there was hope that these bills will receive consideration early in the session.

Occurrence, Constitution and Properties

During 1957 a number of laboratories were engaged in studies relating to the occurrence, constitution and properties of coal. The U. S. Bureau of Mines expanded its program of fundamental studies on coal, carbonaceous materials and their products. Of particular interest was the use of new tools and techniques in approaching the problem of the molecular structure of coal. Studies of microbial attack on coal gave some insight into the biological degradation of organic matter.

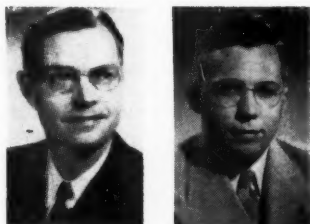
The Department of Fuel Technology, Pennsylvania State University, continued research on the physical chemistry of humic acids and on the forms of sulfur in coal and coke. During 1957 a special appropriation by the State of Pennsylvania for research on bituminous coal and anthracite resulted in an expanded program. Studies are now in progress on the reaction of sulfuric acid with bitu-

minous coals, the preparation of porous carbons from humic acids derived from coal, and a broad study of the chemical nature, physical structure and distribution of ash-forming constituents in anthracite. Also included in the expanded program is an investigation of the effect of radiation on the physical and chemical properties of anthracite, bituminous coal, and coal by-products.

The assessment of coal reserves has continued to be given attention by the U. S. Geological Survey and by Geological Survey groups of the coal-producing states. The Ohio Division of Geological Survey brought to completion a long-term study of the coal resources in the several geologic formations of the state, and prepared a summary study of the work. Additional projects included the geological mapping of Ohio coal beds, a petrographic study of Lower Kittanning coal, and an investigation of the plant microfossil assemblages of Ohio coal beds. The Alabama State Mine Experiment Station, at the University of Alabama, continued its studies on the free-swelling, reactivity and other physical properties of Alabama coals.

The Illinois State Geological Survey in 1957 carried on studies of the constitution of coal, including the effects of mild oxidation and stage carbonization of the weakly acidic groups in bituminous coal. A comprehensive literature survey of recent work on

Harlan W. Nelson and Richard B. Engdahl have combined their talents to present this review of bituminous coal research. Dr. Nelson, a supervisory engineer in fuels and combustion research at Battelle Memorial Institute, has been



H. W. NELSON

R. B. ENGDAHL

associated with much of Battelle's research on stokers, coal gasification and combustion phenomena. He is the author of numerous publications on residential stokers, stoker coals, gasification of solid fuels, pulverized coal, gas burners and combustion technology.

Engdahl's early experience was with the University of Illinois. As research assistant he was engaged in research on residential heating and cooling. Later he became an instructor in the heat power laboratory. Since 1941 Engdahl has been associated with Battelle and has investigated different aspects of combustion and air pollution.

coal oxidation was completed and will be published in 1958. Studies of coal resources throughout the state were continued, including the examination of some 15,000 ft of diamond drill cores for detailed information on coal beds, roof strata and coal measure rocks. The Survey is investigating the reserve of strippable coal in Illinois. Beds of 18 in. or more are being classified with respect to depths of overburden of 50, 100, and 150 ft.

Studies involving coal petrography were continued at the Illinois Geological Survey. A report was prepared covering the influence of petrographic and other factors on the coking characteristics of Illinois and other coals. The Survey continued active participation in the work on standardization of analytical and test methods for coal being conducted on a national and international basis by Committee D-5 of the American Society for Testing Materials. The U. S. Bureau of Mines and other research groups are also participating in this work.

Another research activity of interest at the Illinois Geological Survey involves a fundamental investigation of the plastic properties of coal. Bituminous Coal Research, Inc., initiated a study of the plastic and coking properties of coals. The Commonwealth of Pennsylvania is sponsoring at Penn State the phase of study involving Pennsylvania coals, and BCR is sponsoring an extension of the study to include coal from other states and the development of bench-scale laboratory tests. Data from these tests are to be correlated with data

from conventional analytical tests and with the performance of the coals in small and industrial size combustion equipment.

Mining and Preparation

Research and development work in the fields of mining and preparation is being carried on by many coal producers, manufacturers of equipment, and government agencies. The relation of this work to the economic and competitive position of the coal industry is highly significant, both for the immediate and the extended future.

The Anthracite Division of the U. S. Bureau of Mines is pursuing a program of research on the mining and preparation of anthracite. Following successful tests of a pneumatic, vibrating-blade coal planer in seams of hard anthracite, large-scale tests are being organized in cooperation with an anthracite producing company. A scraper-shaker loader designed by the Bureau of Mines staff was put in operation in a rock slope mining system and is operating satisfactorily. Work in progress on anthracite preparation included an investigation of the use and application of high velocity cyclones to specific sizing and cleaning problems.

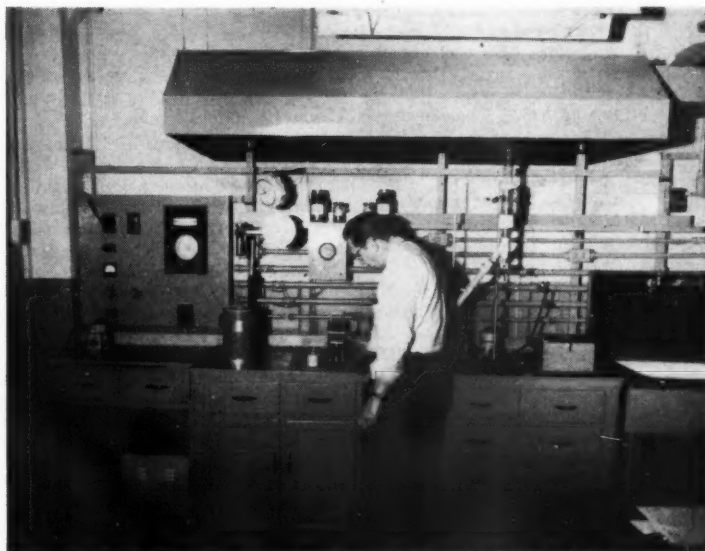
Investigation involving roof strata and roof supports were made by the U. S. Bureau of Mines, the Engineering Experiment Station of West Virginia University, the Illinois Geological Survey and Virginia Polytechnic Institute. West Virginia University also had work in progress on the emission of combustible gases in coal beds and possible ways to degasify the coal in advance of mining operations. Another investigation carried on by this group involves a study of

the relative rates of corrosion by acid mine waters of various types of steel alloys and protective coatings. Studies carried on in 1957 at Virginia Polytechnic Institute include the determination of the amount of coal to be left for permanent support of overburden, and a study of pillar bursts in coal mines.

North American Coal Corp. conducted studies of continuous mining machines which resulted in the development of an automatic control for the water spray on cutter heads, and a self-tramming conveyor for high wall operation. Studies of the utilization of mine wastes were begun.

The mining research program of the U. S. Bureau of Mines included a comparative study of types of face haulage, which until recently has been a bottleneck in mechanized mining. Completion of this study should furnish coal producers with a basis for the selection of systems and combinations of equipment most suitable for existing mining conditions. The Bureau is also studying the relation of the method of mining to the percentage of coal recovered from individual beds. An investigation was begun on the hydraulic transportation of coal, in cooperation with a commercial mine.

The U. S. Bureau of Mines continued its survey of the preparation characteristics of coking coals, and completed a study of a commercial dense-medium preparation plant for recovering coal from jig refuse. The performance of the first modern feldspar jig installed in an American coal-washing plant was determined. One aspect of the elimination of stream pollution by coal washeries was studied by the Bureau, involving a



Preparing for a coal plasticity experimental run in the Pittsburgh laboratory of Bituminous Coal Research, Inc.

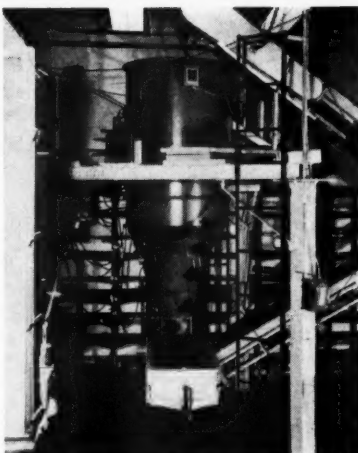
comparison of flocculents, concentrations and filter cloths for the treatment of washing slurries having high clay contents. The Southern Research Institute, for the Tennessee Coal and Iron Division, worked on the development of an instrumental method for the continuous measurement of the rate of flow of solids in coal washer slurries, and a direct-reading, explosion-proof dust counter. Research by the U. S. Steel Corp. in the field of coal preparation included study of the Conventol Process. Other studies in coal preparation were carried on by West Virginia University, Virginia Polytechnic Institute, the Pennsylvania State University, the Illinois Geological Survey, coal producers and equipment manufacturers.

The 1957 research program of the Mining Development Committee of Bituminous Coal Research, Inc., included studies of coal preparation, mine roof support, ventilation controls, dust suppression, and extensible room and face conveyors. The development of continuous mining machines was again emphasized, with studies of a new concept involving the application of gas-generating charges to remove coal from the seam. Studies also were made of controls for automatic mining machines.

Combustion

Several major accomplishments in the field of combustion equipment and coal utilization were announced by Bituminous Coal Research, Inc., during 1957. One was the culmination of a program of research on the development of a coal-fired, package-type automatic steam generator. This unit incorporates a water-cooled pulsating grate and water-take boiler with automatically controlled system for feeding the coal and removing ash. The equipment is designed for use in commercial and small industrial heating plants. Four commercial units were built by the manufacturer, International Boiler Works, and installed in the latter part of 1957. The development and field testing stages of a bin-feed residential heating unit featuring continuous ash removal were completed. This warm-air unit, named the Coal-O-Matic, was placed in commercial production for the 1957-58 heating season.

The development by BCR of the Easy-Flo bin system was an outstanding contribution to knowledge of the handling and delivery of bulk solids from storage. The solids discharge device is applicable to other solids as well as coal, and the device works satisfactorily with moist or dry materials without the need for vibrators. Further tests are in progress at the BCR Laboratories in Columbus under full-scale conditions, which will include a study of minimum headroom requirements.



The BCR Easy-Flo Bin, a bulk storage bin discharge device developed by Bituminous Coal Research, Inc., unloads coal and other bulk solids from bins, silos and bunkers without arching, ratholing or funneling

Work at Virginia Polytechnic Institute in fuel utilization included studies of the effect of fuel size on the combustion efficiency and dust emission of spreader stoker units, and fundamental studies on the combustion of coal. West Virginia University made mathematical studies of methods for predicting the power requirements for crushing coal and its associated mineral impurities.

Pennsylvania State University continued programs of research on the Fire-Jet anthracite stoker and its application to bituminous coals, and on industrial underfeed stokers. Another project begun under grant from the Commonwealth of Pennsylvania was a comprehensive study of the correlation of laboratory tests of ignitability, reactivity and plasticity of bituminous coals with the actual performance of these coals during combustion. Anthracite utilization is also receiving attention under the Penn State program through a basic study of grindability and the mechanism of thermal decrepitation.

The U. S. Bureau of Mines, in collaboration with the International Cooperation Administration, is aiding in a survey of the lignite deposits of India and in determining possible uses for the fuel. The work includes the design and construction of a pilot plant in India for the drying, briquetting and carbonizing of lignite to produce a fuel for domestic use. The Bureau also was engaged in studies of fireside boiler deposits, both on a laboratory scale and in commercial coal-fired furnaces. Work was also done involving the calculation of theoretical flame temperatures in furnaces and the application of the results in correlating data on furnace performance. In a cooperative program of tests with the American Society of Mechanical Engineers, a rational com-

parison was made with the aid of newly developed equations involving adiabatic flame temperature and molar rate of flow of flue gas.

As a continuation of pilot-scale tests of ignition and burning of solid fuels in thin beds, the Bureau published a study of combustion in pure crossfeed ignition and in fuel beds such as exist on stokers with traveling grates. A number of factors were studied in this program, including the rate of travel of ignition through the bed, burning rates after ignition, and the resistance to the flow of air. Also determined were the effects of coal rank, size consist, moisture and ash contents, and chemical treatment upon ignition and subsequent burning.

Work of BCR Locomotive Development Committee in 1957 consisted of testing of their revised coal-fired gas turbine design under a high load factor. A 1000-hour test demonstrated the practicability of the bulk-aerated coal feeding system. They state that the tests indicated that the major problems in fly-ash collection and turbine-blade erosion has been overcome.

The first central-station supercritical boiler began operation in June. The next big step-up in central station efficiency was widely discussed as expected to come from supercharging of the boiler and the addition of a gas turbine, but no construction along these lines is yet scheduled. A joint project on low-temperature flue gas deposits was begun at Battelle Memorial Institute for the American Society of Mechanical Engineers on behalf of a group of utilities and equipment manufacturers.

The 108-mile coal pipeline built by Pittsburgh Consolidation Coal Co. was placed in limited operation pending modification of the terminus near Cleveland.

Processing

Gasification. In an attempt to lower the cost of gasification, the U. S. Bureau of Mines initiated a project for the development of a pressurized, slagging, fixed-bed gasifier. The design of the generator was completed except for the bottom section. Preliminary bench-scale tests were made, and thermodynamic calculations are in progress. Further work was done in cooperation with the Atomic Energy Commission on the development of a gas-cooled nuclear reactor for gasifying coal with steam. Earlier exploratory studies showed that ash from irradiated coal was so radioactive that its disposal would be a major problem. Accordingly, the program now in effect involves a closed-cycle system with helium gas used as the working fluid. Tests of a simulated nuclear system employing electrical heating were run at atmospheric pressure, and construction of a pressurized loop is in progress.

Several programs of gasification research are being conducted at West Virginia University under Bureau of Mines fellowships. These include studies of high-temperature gas reactions at solid surfaces, kinetic studies of the steam-carbon reaction at high temperatures, and gasification of a coal-water slurry.

The Anthracite Division of the U. S. Bureau of Mines is engaged in studies of technical and economic data obtained from previous tests of anthracite in a commercial Lurgi gas generator. Hydrocarbon Research, Inc., continued work on a gas generator for anthracite in cooperation with a commercial anthracite producer.

The Institute of Gas Technology continued its investigations of the production of pipeline gas from coal under a research program sponsored by the American Gas Association. Work announced for 1957 involved the pressure gasification of low-rank coals by a dispersed-phase thermal process in the presence of hydrogen-rich carrier gases.

Hydrogenation. The Bureau of Mines developed a new type of laboratory reactor for hydrogenating coal at high temperatures and pressures. Its use minimized the time required to heat and cool the coal, requiring only 1½ minutes for the heating stage and one minute for cooling.

Autoclave tests were used to screen a variety of iron compounds as potential catalysts. Metal naphthenates were found to be good hydrogenation catalysts as, unlike inorganic metal compounds, they do not require impregnation on coal. When distillate type liquid fuels are desired instead of gasoline, simpler and less expensive coal hydrogenation systems may be possible. The Bureau is making pilot-scale tests at pressures of 2000 psi rather than the conventional 8000 to 10,000 psi, which permits use of cheaper and more conventional materials of construction.

Fischer-Tropsch. The Bruceton Laboratories of the Bureau of Mines continued their studies of the poisoning of iron Fischer-Tropsch catalysts by sulfur compounds. Larger amounts of sulfur were required to poison the catalyst by impregnation than were required to poison it during use. Sulfur dioxide was found to be more detrimental than hydrogen sulfide. Various forms of massive iron, including turnings, steel wool, wire, screen, and steel plates, were prepared and pretreated in various ways to obtain catalysts suitable for the hot-gas-recycle process. Pilot-plant studies of the hot-gas-recycle process showed that excellent control of temperature was possible at temperatures as high as 300°C. Nitrided iron at lower temperatures gave high yields of alcohols in this process.

Carbonization. The Illinois Geological Survey conducted studies of coal carbonization designed to demonstrate the behavior of Illinois coals in blends with eastern coal of about 22 percent volatile matter. Tests in their 17-in. pilot coke oven showed that exceptionally strong coke could be made and that the blends show low expansion pressures even with 50-50 mixtures. Other tests were run on a variety of coal blends to determine the effect of coking time (12 to 28 hours) on expansion pressure. It was concluded that pressure tests for comparative purposes should be made at the rate of coking to be used commercially. A study of the effect of weathering of Illinois coals on carbonizing properties was completed.

In addition to plant testing and coke-evaluation activities, the U. S. Steel Corp. conducted studies of the optimum degree of pulverization of coals to be used in coking blends, and the relation of basic coal composition to the thermal behavior of coal. West Virginia University made studies of a dielectric determination of the coking qualities of coal, and of the reaction kinetics involved in the hydrocracking and thermoc cracking of lignite tar fractions. Pittsburgh Consolidation Coal Co. continued its coal research program, with activities concentrated principally in the area of coal processing to yield chemicals and specialty products. Some of the results and know-how obtained by previous research activities were commercialized by the establishment of a new cresylic acid plant in Newark, N. J., and the construction of a coke calcining plant at Cresap, W. Va. Plans also were announced for the construction of a low-temperature char plant at Cresap, the char from which is to be burned in the plant of an electric utility company.

The program of research of Eastern Gas and Fuel Associates was concerned with the study of optimum carbonizing procedures. Its laboratory conducted tests of numerous coal blends in a movable-wall oven, and developed an automatic device to record oven pressures continuously. A pilot-scale electrically-heated oven was used for studying the effects of carbonizing variables on the quality of coke, and a sole-heated test oven of improved design was constructed.

Pittsburgh Coke and Chemical Co. announced a method for producing fibrous carbon from coke oven gas, and further studies are in progress. Research on activated carbon from bituminous coal, tar-epoxy mixtures for protective coatings, naphthalene derivatives, and the broad field of chemical utilization of coal and its by-products was actively carried on.

The Southern Research Institute continued technical and economic studies of a low-temperature carbonization process recently announced as

being under development. Plans have been made for an expanded experimental program in this field during 1958. Pennsylvania State University began a study of the production of chemicals from bituminous coal by the use of prehydrogenated aromatic fractions. The Anthracite Division of the U. S. Bureau of Mines continued studies of the use of anthracite as a metallurgical fuel, and a continuous, vertical pilot-scale retort was built for calcining anthracite. Tests of an agglomerate anthracite as a metallurgical fuel showed it to have properties comparable to either foundry or furnace coke in regard to resistance to impact and abrasion.

The Bureau of Mines, in cooperation with three western steel companies and the Colorado School of Mines, studied the coking properties of western coals using two types of test ovens and auxiliary bench-scale tests. The Bureau's survey of coking properties of United States coals was continued, as were additional studies of the effect of variables such as the cleaning and preheating of the coal before charging, length of coking periods, pressures developed, flue temperature, and bulk density. Correlations have been found between the fluidity of coal during carbonization and the nature of the coal, effect of added inerts, and final coke strength. Increased effort was devoted by the Bureau to the study of low-temperature tars, including methods of concentrating and upgrading tar fractions into more marketable products.

The Seventh Annual Gordon Research Conference on Coal was held at New Hampton, N. H., in June. The Program of this off-the-record conference was devoted to coke and coal carbonization.

Research Abroad

Great Britain

The British Coal Utilization Research Association and the Fuel Research Station of the Department of Scientific and Industrial Research continued large programs of investigation into many aspects of improved uses for coal.

At BCURA, development continued on a modified chain-grate stoker for shell-type boilers featuring controlled primary air distribution. Pilot-scale studies of bonded fireside deposits and corrosion in pulverized-coal-fired boilers were made, including the effects of protective tube coatings and dolomite additives. Humidification of the combustion air softened the deposits but ease of removal was unaffected. In a miniature furnace, an increase in coal fineness was found to increase the acid content of the flue gas. Work on removing SO₂ by converting to SO₃, then cooling to form mist and trapping the mist in a falling cloud of sand was abandoned because too much

sand was required. The conversion to SO_2 was 75 percent successful using a vanadium catalyst.

A report was issued on the results of work on the cyclone combustor. From tests on many coals, the ratio of the percentage silica to the major oxides in ash was found reliable for assessing the suitability of coal for the cyclone. Work has begun on gasification in a fixed-bed, slagging producer to produce gas for heating as well as synthesis gas for liquid fuel. BCURA has reported considerable interest in central heating, and an Association-developed indoor-outdoor-temperature controller is to be manufactured.

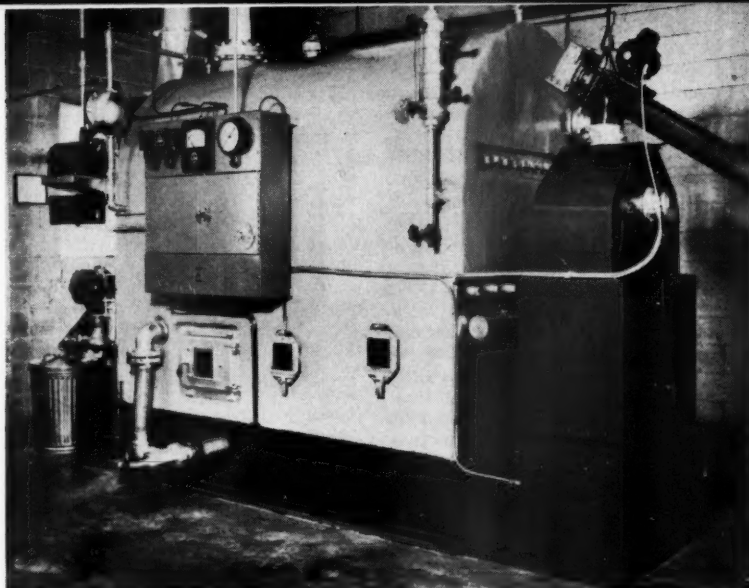
Fundamental investigations of coal structure continued. Previous work on treatment of low-rank coals with chlorine trifluoride was extended to assess the effect of operating variables on the yields of potentially useful fluorocarbon oils.

Field development continued on the Venturi-pneumatic pyrometer for measuring gas temperatures far above the range of thermocouples and on the BCURA dust-sampling probe. A flame evaluator is under development.

An increasing proportion of the work of the Fuel Research Station is concerned with the measurement and prevention of atmospheric pollution caused by the combustion of coal, and also with the production of liquid fuels and chemicals from coal using the Fischer-Tropsch process.

Work has continued on the testing of domestic open fires, stoves and boilers burning solid fuel. Newly developed open fire grates have the advantage that while they will burn bituminous coal effectively they are also suitable for burning the less reactive types of smokeless fuel. The Station has been successful in making coke that can be ignited and burnt easily in the older types of domestic firegrate. This coke can be made from relatively abundant, weakly caking coals in an ordinary gasworks plant. The process is being integrated into a gasworks of the North Thames Gas Board and the product is on sale.

With increasing use of nuclear reactors in the future to produce electric power, it may eventually be economically practicable to make oil synthetically from coal. The Research Station is studying the slurry process as one approach. Investigations into methods of gasification in Great Britain and in other countries have indicated possible ways of greatly reducing the cost of making synthesis gas and of the process as a whole. Work on the Fischer-Tropsch process is being increased. It has been shown that gamma irradiation of unreduced mill-scale catalyst from cobalt-60 brings about a significant and permanent increase in activity. A new method of gasification was studied in which a suspension of powdered fuel



The International-BCR Coal-Pak Automatic packaged steam or hot water generator has been engineered for unit installation in commercial, small industrial and institutional plants for space heating, process hot water and high-pressure process steam

in the gasifying medium is passed at high velocity through a chamber at a temperature of about $1500^{\circ}C$, with the ash discharged as liquid slag.

Work at the University of Sheffield as part of the D.S.I.R. program has shown that it is not necessary, as has often been asserted, to have a smoky atmosphere in furnaces for reheating steel to produce steel of high quality.

Tests are being carried out in power stations using coals of medium and high chlorine content to discover what effect these coals have on the formation of deposits on the external heating surfaces of the boilers.

The C. A. Parsons & Co., Ltd., reports successful operation of a 500-hp open-cycle coal-fired gas turbine. At a comparatively low turbine inlet temperature of $1070^{\circ}F$, 800 hours of operation on coal indicated several thousand hours' operation would be possible before erosion by ash would seriously weaken the turbine blades. A fluidized coal feeder was used successfully. Future work will be concentrated on nonslagging combustors. A closed-cycle gas turbine for a locomotive has been tested for 200 hours. No corrosion or blockage of the heat exchanger was experienced. It is expected that the locomotive will be completed in 1958.

France

Work by the Centre d'Etudes at Recherches des Charbonnages de France, Cerchar, was carried on at the Verneuil laboratory and at three semi-industrial locations. Nearly half of the research was on mine safety, including silicosis, and on electrification and mechanization. A study also was made of the hydraulic conveyance of coal.

Another major effort concerned mechanical preparation, briquetting, and

carbonization. Pilot-scale tests were made of the new "Lavodune" process for the hydraulic handling of fines and on a fluidization plant producing semi-coke at the rate of one tph. Some work was done on automatic briquetting to produce small agglomerates weighing between 10 and 20 grams for use in automatic furnaces. Seventeen percent of the laboratory effort was devoted to combustion in small industrial and domestic equipment. Considerable effort was continued in studies of the structure of coal.

Canada

The Fuels Division of the Canadian Department of Mines and Technical Surveys carried on strata-stress investigations in coal and metal mines and tests on occluded gases in coal. Work was done also on coke quality using a number of coals and on the effect of mechanization on size consist and washing properties. In cooperation with the British Columbia Department of Mines a study was started of the correlation of coal seams by means of trace elements. Some work was done also on coal sampling, metallurgical uses, mine dust explosibility and the cyclone smelting of iron ore.

In connection with the future application of lignite to power generation the provincial research council and the Saskatchewan Power Corp. have undertaken to conduct assays for tar yields and studies of carbonization properties with specific regard to the Parry process.

Germany

A new research establishment for the German Coal Industry is being built by Steinkohlenbergbauverein (St.B.V.) at Essen. The first building

(Continued on page 124)

GOLD IN 1957

Current changes in business conditions suggest the possibility of a more favorable economic climate for gold miners in the future

By DONALD H. McLAUGHLIN
President, Homestake Mining Co.

GOLD mining is supposed to be prosperous in times when the economy slows down and traditionally to suffer in times of booming activity. Consequently, in a rather wry way, the miners who are still surviving in this long depressed business may take a little comfort from the growing signs of trouble in other fields and may even derive some satisfaction from the stability of their meager incomes as compared with the change from riches to poverty experienced recently by the producers of copper, lead, zinc, and most other metals. Whether or not the turn of events at the end of the year will be of much significance to them, however, is still uncertain. If we are about to enter a depression adequate to atone for the sins of inflation at their present stage, the immediate prospects for better profits from gold mining are bright; if on the other hand the feverish boom is revived by more of the same stimulants that have been used since the war, further inflation will be likely

and the pinch on earnings from gold mining will be more and more painful.

Under the latter circumstances the depression may be postponed, but it will be more severe when it eventually arrives. The gold miners would have a few more lean years to sweat out until the mounting pressures created by further inflation finally bring about a truly disastrous break. If ore reserves last long enough, gold miners might stand to gain from the delay and from the more drastic devaluation resulting in a higher price for gold in smaller dollars that these conditions will bring about. But surely they would be glad to give up these hopes for distant riches and settle for a milder recession at this time with much smaller benefits to them, if it would lead to sounder monetary policies related to gold.

From these comments, some unkind critics might charge the writer with being a cheerful sort of Cassandra, actually taking satisfaction in the dire consequences predicted for others.

They might even go so far as to imagine he thinks that what is bad for the country is good for the gold miner. That really isn't true, for the worst program for our country would be to continue present monetary policies and to drift further into the soft habits of an inflationary prosperity maintained by excessive spending. This has already been nearly fatal to the gold mining industry.

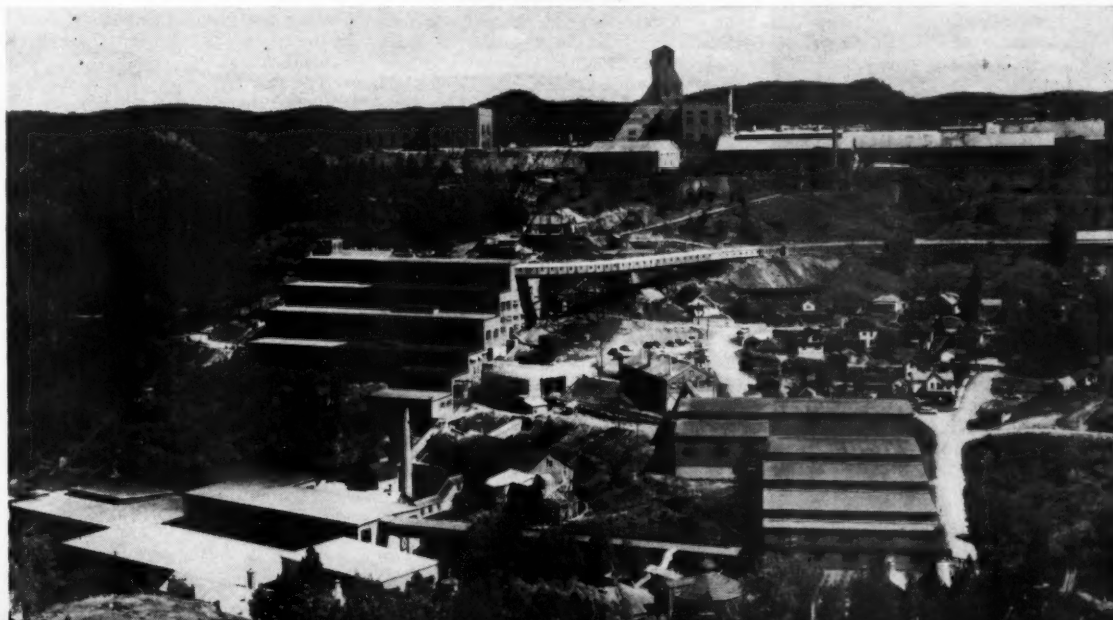
Gold—A Strong Weapon To Fight Inflation

If the commitments of the federal government and the special guarantees and obligations such as Social Security, pensions, housing subsidies and the like, are added to the formal debt of \$275 billion, the figures that we expect coming generations to meet become truly astronomical. The Social Security liability alone, partially funded only by other promises to pay, is estimated by some to be as great as \$350 billion. Truly it would be in the national interest to check this freedom with the money of future citizens and to restrain the growing practice (national and personal) of living more and more on credit. If this is not done, the end will be a drastic reduction if not complete repudiation of these excessive obligations through a truly disastrous inflation.

A strong weapon in the fight against these dangers and in progress toward financial integrity is gold, and the sooner conditions develop that reveal its power and that persuade our leaders in government and finance to use it, the better the country will fare.

Consequently, it is reasonable to think that even a recession at this stage—harsh medicine though it might be—is needed to prevent greater ills in the future. Whatever improvements might come to gold miners from such an event would be small in comparison with the long

The Homestake mine, this country's largest producing gold mine, almost held its own this year, but returns from other regions fell off substantially



range benefits gained by the country as a whole. It is truly a satisfaction to feel that the special interests of the gold miners actually are identical with the best interests of the country, which of course puts us in a position that can be strongly defended morally as well as on the grounds of enlightened self-interest.

The change in business conditions toward the end of the year, however, merely suggested the possibility that the economic climate might become more favorable for gold miners in the not too distant future. No improvement in profits from gold mining actually occurred in 1957, though the more abundant labor supply and the more intensive competition among sales agents that were apparent in the last quarter might soon begin to have an influence on costs, if such trends continued. For the year as a whole, however, we can only record that the same discouraging increase in costs and decline of profits continued.

In spite of this, the production of gold for the free world as a whole will be greater than in 1957. This rather contrary result was due entirely to the growing output of South Africa as the new mines on the deep reefs in the Orange Free State came into full production and as the returns from uranium offset losses and postponed the closing of a number of mines on the older Rand. These extraordinary conditions will probably lift the record of gold production to a new high for these immense deposits and will more than offset the continued decline in gold production elsewhere outside of Russia. South African production for 1957 is likely to be close to a million ounces higher than in 1956, which will probably result in an increase of 300,000 to 400,000 oz in the total output of the free world, bringing it somewhat over a billion dollars in value.



High wages demanded by labor along with domestic inflation have made the United States an extremely high cost country

Gold Production Down in U. S., Canada

In Canada, the United States, and elsewhere, no new gold fields or even gold mines of any significance were found and developed to offset the growing restrictions resulting from higher wages and cost of materials. Unfortunately none of the gold ores on this continent contain uranium, though a few gold mining companies on this continent have had some success in the development of uranium properties acquired in other areas. Canada is still in a strong second place among the gold producers, even with a production that will be 100,000 oz less than in 1956.

In the United States, the Homestake Mine has held its own fairly well, with a production of around \$19,300,000, very close to that for 1956. Returns from other regions fell off, however, to an extent that will probably make the final figure for national gold production well below last year's. Curtailment of production from certain of the porphyry coppers that contribute a substantial percentage of the nation's gold will also reduce the totals somewhat.

The United States may show a decline of as much as 200,000 oz when final figures are in. In Canada the normal troubles of the times for gold miners were aggravated by the relative weakness of the United States dollar that reduced the gross value received for their gold in the currency that had to be used to meet payrolls and expenses. Gold has declined from its proud place at the head of the list of Canada's metallic products to fifth place, and the growing output of uranium will soon put it in sixth place.

The immense output of gold from South Africa, in the last few years, has undoubtedly been a decidedly beneficial factor in the world's economy, for it has kept the discrepancy between obligations expressed in paper currencies and the available stock of monetary gold from becoming too extreme. As these basic factors now stand in relation to each other, new ratios could be set and new monetary units still could be defined in gold at figures that could be supported and that would not require an increase in price of gold too great to be easily entertained.

In spite of their inconsistencies, the present policies concerning gold are still supported and defended by the monetary authorities in the United States. The dollar is still defined in terms of gold, for it alone has basic authority as money; but the definition loses its meaning by the restrictions imposed on convertibility that make inflationary financial practices difficult to restrain, particularly on the domestic level where the protection of gold is completely denied to the citizens. The money managers are in the

Donald H. McLaughlin, president Homestake Mining Co. is the natural spokesman for domestic gold miners. He



is chairman of the Gold Producers Committee of the American Mining Congress and is well known for his active and vigorous work in behalf of the whole mining industry. Besides being a successful executive, Dr. McLaughlin is renowned for his many major attainments in the fields of geology and engineering education, and is the author of many articles of importance to the mineral industries.

strange position of trying to present a respectable front to the world by maintaining convertibility of the dollar into gold at \$35 per oz through foreign central banks, while retaining full freedom to monetize debt and depreciate the dollar domestically. Until recently, the productive strength of America in contrast with the postwar weakness of the European countries and Japan has made it possible to maintain this position, though it could not have been done without the help of immense grants of various sorts.

Foreign Technology Becoming Competitive

Furthermore, thanks to domestic inflation and to increases in wages forced by unions at a rate faster than the dollar depreciates, the United States has become an extremely high cost country in spite of our advanced technology, particularly in mass production. Faced with the mounting and increasingly skillful competition of Europe (Germany in particular), Japan and before long of Russia, there is clearly danger that exports will decline with possibly rather serious effect on an economy that must maintain its output and sales at high levels to attain competitive costs. Tariffs or trade restriction, now so loudly demanded by those who are already feeling the painful impact of foreign competition, are not apt to help the overall situation.

The money managers apparently want it both ways. At home, the power of gold is denied. Abroad, it is recognized by a rate of convertibility that makes the dollar an overvalued monetary unit. Sale of American goods abroad under these conditions has been possible only by the artificial device of offsetting dollar and gold balances payable to us by grants and aid on a vast scale.

Our international trade could be sustained without grants or other support if the gold standard were restored on the proper basis. Foreign aid could be reduced and eventually terminated, with gradual transformation to the normal procedures of a free economy in which goods are ex-

changed internationally under conditions beneficial to each participating trader.

Most students of the problem recognize that the effects on trade brought about by foreign aid could be accomplished as effectively but in an impartial way by an increase in the price of gold. The principal arguments against the latter procedure are (1) that it would then not be possible to direct our aid to selected "friends," for an increase in price of gold would necessarily apply to all, and (2) that such an increase would be particularly beneficial to Soviet Russia.

Monetary Standard Needed In International Trade

Even if it were assumed that our program of selected beneficiaries had achieved the desired objectives—a rather extreme assumption, as a survey of the current scene will indicate—it surely is inadvisable to continue it until financial aid from us becomes regarded as an obligation on our part that can't be dropped without dire consequences. Indeed, in places it appears to have attained this standing already, when aid is continued more on account of threats of reprisal than for mutual benefits.

"Trade not aid" is a slogan which if put into practice will win more friends in the long run than gifts. Convertibility of currencies in terms of gold, however, is necessary to give it practical meaning. Interchange of goods and normal business could then be conducted with assurance and with the mutual respect that is clearly lacking when favors are offered and accepted either with suspicion as to motives or with more or less concealed contempt for the simplicity of the benefactors.

Without entering into the debate over results to date, the time is surely near for a change from aid to trade—and that can be best accomplished through establishment of currencies convertible into gold.

Russia's Gold Position Growing Stronger

The argument that restoration of the gold standard with an increase in price of gold would be of special aid to Russia is of very doubtful validity. Russia undoubtedly has accumulated a substantial gold reserve, probably considerably less than the actual quantity of gold we hold, but possibly greater than our net balance after short term claims against our assets are taken into account. The Russians are using it only sparingly in payment of occasional imports, presumably because other means of exchange are limited. If trade with Russia is to expand—and what better way is there to promote mutual understanding and respect?—stable currencies

convertible freely into gold that would be accepted by all participating countries are essential. The devaluations of the ruble have in all probability put a valuation on gold in Russia that is in reasonable relation to domestic prices for major industrial commodities. Adjustment of the already depreciated currencies in the rest of the world to gold will have to be made before relative values suitable for mutually beneficial trade can be established.

The building up of gold reserves of the magnitude now held by Russia—or of gold mining activities on a large scale—have undoubtedly required a major effort, involving engineering and geologic talent, the use of large amounts of machinery and materials, and the employment of labor in substantial quantities. Such expenditures surely were not undertaken lightly in an economy that must have had to meet many other severe demands. Russia has undoubtedly paid a big price for its present gold position, however one may measure prices in the Soviet economy. It would be most unwise on our part to think that this was done without intent to use the power that gold alone provides in worldwide exchange of goods. A sudden announcement of a ruble convertible into gold at a fixed rate for use in international trade could bring Russia as much new prestige as their success in sending up the first satellite. This will probably be done just as soon as the Russian economy has reached a stage where exportable surpluses are available in significant quantities. Before long, the Russian competitive position in foreign markets will undoubtedly be much stronger. With the added assurance that a ruble convertible into gold would give them, the rest of the world would be in a most disadvantageous position if earlier steps had not been taken to put the dollar and European monetary systems in better order. With the free world still in possession of the largest gold reserves as well as the greatest producing gold fields, the initiative in wise employment of the basic monetary power of gold surely should not be lost.

Gold and Mutual Respect

A higher price for gold—or more accurately, an adjustment of the already depreciated currencies to the stable value of gold—would certainly not be to the disadvantage of the West, whose combined strength in gold is far greater than the Russian's. Such a move would be to the advantage of both sides of the divided world by stabilizing currencies in terms of a generally accepted unit. The assurance of dependable and impartial settlements that this would give would surely be of immense help to multilateral trade and could well do more to promote peace and mutual respect

between nations than any other means.

The complexities of specific steps to achieve these ends are formidable, but not beyond our powers if the objectives can be agreed upon. Unfortunately, little or no recognition of the seriousness of the problem is discernible on the part of those in high places in our government or seen in banking or business circles. (American bankers, strangely enough, are rarely if ever interested in basic monetary problems.) Time unfortunately is becoming short, and it is most worrisome to think that we are probably in danger of another defeat in the international position through failure to make wise and timely use of the immense power we possess through gold.

For several years the American Mining Congress has recommended that "Congress fix the ratio at which the dollar and gold are to be made fully convertible and determine other technical procedures involved in the restoration of the gold standard, after receiving the recommendations of a Commission of its creation, to which men skilled in appraisal of the world's potential gold supplies as well as men of competence in domestic and international finance and trade should be appointed by designated Government authorities."

The urgency of the situation calls for more direct action, but without agreement on principles and procedures this cannot be expected unless forced by harsh circumstances. But perhaps it is not too much to expect that a careful study by a competent commission would bring forth a program that could be approved and adopted in time to be effective, as a means of controlling inflation, of lessening the severity of the depression that we must eventually expect, and of strengthening our position in world trade.



South African gold production for 1957 is likely to be close to a million ounces higher than in 1956

Review of Silver in 1957

- Market Prices Steady
- Imports up from 1956
- Future Increase in Price Justified

By L. J. RANDALL

President, Hecla Mining Co.

"AT this point in the world's history, the future of silver holds great promise. To bring that promise to its fullest reality we need to reorient silver to the world trend, both in coinage and in commerce. We need to think forward into the future instead of back into the traditional past."

These are the words that Senator Wallace F. Bennett of Utah left with us at a recent convention of the American Mining Congress. His advice inspires us to study and promote the use of silver in monetary and industrial fields with a view to making it more valuable. Silver is popularly known to everyone, but more reassuring to those who produce it are its characteristics of conductivity, alloying, bonding as a solder, its use as money, and its value and beauty in household use and ornamentation.

Silver was widely mined and highly revered in Ancient and Medieval times. Through several centuries in the first millennium, B. C., more than 250 million ounces were produced in the silver districts at Laurium, Greece, and production continued there during the era of the Roman Empire as well as in some European countries during the Middle Ages.

A tremendous increase in the world production rate of silver began soon after the discovery of the New World, where deposits were not only more extensive but also richer than any previously found in the Old World. The rich deposits were in Mexico, Bolivia and Peru. Bolivia led in the production of silver for two centuries and then was replaced as the world leader by Mexico; and except for 30 years prior to 1900 when the Comstock made the United States the number one producer, Mexico has continued in first place.

World production since 1493 has been 20.4 billion ounces, 82 percent of which came from the Americas and

L. J. Randall is an excellent example of how someone with formal training other than mining can be successful in, and contribute much to, the mining industry. A business graduate of the University of Idaho, Randall is president of Hecla Mining Co., chairman of the Tax Committee of the Mining & Metallurgical Society of America, a member of the Tax Committee and a director of American Mining Congress. Les Randall will be remembered by many readers for his outstanding work as national program committee chairman for the 1955 AMC mining convention in Las Vegas.



three-fourths of that from North America. Of the world total Mexico has produced 35 percent; United States, 21 percent; Peru and Bolivia, each 9 percent. One-third of the world production is estimated to be in circulation as coinage or held by governments for that purpose; one-third, hoarded or privately owned; and one-third, lost or dissipated.

During Colonial days the importance of incorporating silver in the monetary system was clearly demonstrated in order to stabilize and redeem paper currency, most of which otherwise was of little value. The Spanish milled dollar became the most widely accepted silver coin in the Colonies, but its scarcity posed a great problem. Because of the stable purchasing power of the Spanish milled dollar there was little need for gold coin in circulation; in fact, the British crown and the French Louis were largely hoarded and available only in limited quantities.

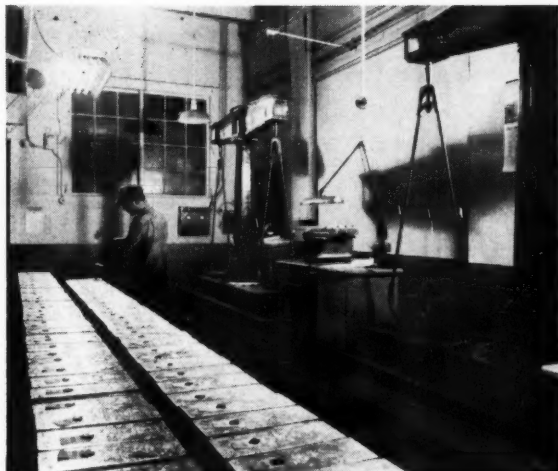
The bitter experiences of the colonists were foremost in the minds of the authors of the Constitution and of the Members of the First and Second Congresses and were reflected in

their determination to have a monetary system based on silver and gold, resulting in the enactment of the First Coinage Act approved by President Washington on April 2, 1792. This law stipulated that 371¼ grains of pure silver and 24.75 grains of pure gold equal \$1.00 (making one ounce of silver worth \$1.29 and an ounce of gold, \$20.67). Copper was designated as the alloy for silver coins, and silver and copper the alloy metals for gold coins, 11/12th fine, and silver dollars 892.4/1000ths fine.

The silver content of the silver dollar has not been changed, but by the Act of January 18, 1837, the copper content was reduced to give the silver dollar and subsidiary coins a fineness of .900. In addition, the silver content of subsidiary coins was decreased by the Act of February 21, 1853, from 371¼ grains per dollar's worth to 345.6 grains. In effect, this raised the monetary value of subsidiary silver to \$1.38 an ounce. The First Coinage Act also provided for a coining charge of one-half of one percent of the pure gold and silver delivered to the Mint.

The trade dollar which contained 420 grains of standard silver temporarily replaced the silver dollar by the Act of February 12, 1873, but the Act of February 28, 1878, restored legal tender status to the silver dollar but did not restore the free coinage of silver, and the Mint was no longer required to buy all silver tendered. As a result of the cessation of the free coinage of silver, the market price began to fall. Silver certificates of ten dollars each were authorized under this Act, and the Act of August 4, 1886, authorized the issue of silver certificates in smaller denominations. Both "Silver Profit Fund" and "seigniorage" are mentioned in subsequent statutes.

By Presidential proclamation issued on December 21, 1933, the Treasury



Much progress has been made during the past ten years in the field of industrial uses where silver has proven to be, in many instances, practically indispensable

was directed to acquire newly mined domestic silver at 64.64 cents an ounce, which gave the Government a profit of 100 per cent since this silver was coined and circulated at \$1.29 an ounce. Presidential proclamations issued under authority of the Silver Purchase Act of 1934 increased the price to 77.57 cents an ounce on April 24, 1935; on July 6, 1939, the statutory price was fixed at 71.11 an ounce, and the present statutory price of 90.5 cents an ounce was established under the Act of July 31, 1946. The various prices were fixed by stipulating the percentage of seigniorage (profit) to be deducted from the monetary price of \$1.29 an ounce.

Seigniorage was referred to during the reign of Edward III in 1345 as "a deduction made at the mint," although the name originated in the 13th century, but the practice of withholding a part of the gold and silver to be coined originated prior to that time. The money thus raised was retained for the personal use of the King for which no service was rendered. This practice often deterred merchants from sending bullion to the Mint. Some of the seigniorage so acquired by the King was the result of clipping or filing gold and silver coins, while other seigniorage was the result of withholding a portion of the bullion intended to be coined. It was the amount paid by the merchant for the privilege of having bullion turned into coin. Not all of the bullion withheld or metal clipped from the coins went to the King. Some of it was retained by the officers of the Mint and called "brassage," or charges for coining the bullion.

Silver Legislation

Bills have been introduced by New England Senators and Congressmen, in almost every Congress since 1935, designed to repeal the Silver Purchase Acts of 1934, 1939 and 1946, but to no avail. The Senators from the West know only too well that the silver

content of the lead-zinc and copper ores in many instances make it possible to operate the base metal mines which produce silver as a by-product, and that a lower price for silver might cause many of those mines to close. They are further cognizant of the harvest of more than \$2 billion in seigniorage reaped by the Treasury since 1792. They also know that the Constitution provided that silver and gold reserves be maintained for coinage and as backing for currency.

Industry has benefited greatly by a provision in the 1946 Act which permits the Treasury to sell silver from the seigniorage fund for industrial uses at not less than 90.5 cents per oz. This was the first time in history that the Treasury was permitted to dispose of its silver for industrial uses in peacetime at less than the monetary price of \$1.29 per oz.

Monetary silver in the amount of 902,000,000 oz was loaned to industry for use as bus bars in plants engaged in producing materials for war use in World War II, and was returned to the Treasury after the war. 135,000-000 oz of non-monetized silver were also sold for consumptive uses to war plants in World War II.

Market Prices

The New York market opening price of silver in January was 91½ cents per oz, the highest for the year, and fluctuated during the succeeding eleven months in a rather narrow

range to a low of 89½ cents per oz, on December 31, 1957.

The all-time average annual low market price of 27.89 cents occurred in 1932; the high, \$1.38 in 1919.

Fluctuations in the London silver market also were minor during the first eleven months of 1957 when prices ranged from 77½ to 80½ pence per oz. In the Bombay market, prices fluctuated more widely from 172.14 rupees to 187.06 rupees per 100 tolas (U. S. equivalent of 95.7 cents to \$1.04.)

Treasury Acquisitions and Sales

All of the silver mined in the United States during the first eleven months of 1957 went into the market except 4,241,429 ounces which the Treasury acquired. This indicates a tight situation for industrialists in their eagerness to control the market price at a figure close to the Treasury price of 90.5 cents per oz. In view of the fact that they have not pressed this year for action designed to repeal the so-called Silver Purchase Acts, they are evidently cognizant of the value of the privilege of buying silver from the Treasury at 91 cents and may not be anxious to resume the agitation for repeal before the seigniorage fund is depleted a few years hence.

Treasury sales of seigniorage silver from January to November for industrial uses amounted to 3,872,124 oz. Industry is taking advantage of the privilege of buying Treasury silver in order to forestall any bullish pressure on the New York market.

There is current opinion that the 1946 Act permitting the Treasury sale of non-monetized silver at not less than 90.5 cents has been a deterrent to a higher price of silver, and should be repealed. However, if the Act were repealed the Treasury purchase price would automatically revert to 71.11 cents under the Act of July 6, 1939.

Imports and Lend-Lease Returns

Silver imports of ore and base bullion and refined bullion during the first eleven months of 1957 totalled 293,277,738 oz. The 1956 figure is 162,820,000 oz. These 1957 figures include 89,779,704 oz of lend-lease silver returned to the Treasury. These imports greatly exceeded the average annual figure of 88,790,000 oz im-

Summary of Lend-Lease Silver

	Amount Lend-Leased	Amount Returned	Balance Due
Australia	11,773,093	11,772,730	363
Belgium	261,333	261,333	none
Ethiopia	5,425,000	none	5,425,000
Fiji Islands	196,364	196,364	none
India-Pakistan	225,999,904	49,276,902	176,723,002
Netherlands	56,737,341	52,405,914	4,331,427
Saudi Arabia	22,347,431	none	22,347,431
United Kingdom	88,073,878	86,047,617	2,026,261
Totals	410,814,344	199,960,860 ¹	210,853,484

¹ Other amounts received in this country, or en route from India and Pakistan, have not been taken into Treasury accounts. Arrangements have been concluded for return of the balances due from India, Netherlands and Pakistan; and it is assumed that arrangements soon will be made for return of the amounts due from Ethiopia and Saudi Arabia.

ported from 1949 to 1954, a normal period.

Of the total amount of 410,814,344 oz of silver lend-leased to nine countries, 199,960,860 oz had been returned and taken into account of the Treasurer of the United States as of November 31, 1957; 183,081,054 oz were in the process of being returned; and 27,772,431 oz are yet to be returned.

As this silver is returned it is deposited in the General Fund in an account now known as "Other Silver Bullion" and may be coined into subsidiary coins and issued to the public at \$1.38 plus per oz, or sold for industrial uses at any price designated by the Secretary of the Treasury from 90.5 cents to \$1.29 under the Act of July 31, 1946.

The "Other Silver Bullion" account, formerly called "Free Silver" contained 127,390,750 oz on December 31, 1957. This account has grown from a low of 10,319,392 oz on March 1, 1955, and will continue to grow until the remaining 210,853,484 oz of lend-lease silver are returned, assayed and taken into the account of the Treasurer. But it will be reduced gradually as it is coined into subsidiary coinage or sold to industry over the coming three to six years. At the end of this time a serious scarcity of silver will develop.

During the first eleven months of the year, 48,030,014 fine oz were consumed in United States subsidiary coinage. This compares with 27,614,838 oz coined during 1956—an increase of 47.3 percent.

New Commercial Uses

Much progress has been made during the past ten years in the field of industrial uses where silver has proven to be, in many instances, practically indispensable. Its characteristics of malleability, ductility and conductivity of electricity and heat have captured the interest of the fabricating industry. Silver-copper and silver-zinc alloys are also used extensively. The photographic industry consumes large quantities of silver in the manufacture of photographic film.

Silver plated bearings were proven, during World War II, to give high-duty service and long life in aircraft. Nickel-base silver impregnated materials, reported to have superior extreme-temperature characteristics, have recently been developed for the Air Force to extend the upper temperature limits of materials used for bearings in gas turbine jet engines and were to replace those already operating at their high-temperature limits.

A more recent use is a silver oxide-cadmium-alkaline secondary battery. It is claimed that the watt-hours per unit of weight and volume are from four to six times that of the lead-acid, the nickel-cadmium or the nickel-iron

batteries, and that it is capable of extremely rapid discharge and long charged shelf life. Another new development is a line of solder end and silver-braze end bronze valves which are recommended for general full-flow service on steam and hot and cold water lines. Still another is an improved material claimed by its manufacturer to make brazing as simple as sealing an envelope.

Silver compounds continue their use in pharmaceutical fields for caustic, astringent and antiseptic purposes. It is also used in dental fillings and in surgery for suture wires and plates. Another old line use, silverware, has skyrocketed. A recently published article stated that more sterling tableware was sold in the last ten years than in all previous history.

Price Should Be Raised

Mining men realize silver's prime importance to the base metal mining industry. Indeed, in many mines silver is the margin of profit. In 1954—\$20 million of the \$33 million total silver production was derived as a by-product from lead, zinc, and copper operations; and in 1955, \$23 million of the \$33 million.

It is particularly fitting that the need for a higher price for domestically mined silver be emphasized as a means of providing aid to stricken domestic copper, lead and zinc mining, which is fast becoming dependent upon silver values to continue operating.

The Secretary of the Treasury has ample statutory authority to decrease the seigniorage profit on silver acquired from domestic miners. The Act of July 31, 1946, requires the Secretary of the Treasury to accept all domestically mined silver tendered

for which he must pay 70 percent of the monetary price of \$1.29 an ounce. This leaves a profit in the hands of the Treasury of 30 percent, or the equivalent of 38.79 cents per oz. However, the Treasury makes an even greater profit when it coins subsidiary coinage at \$1.38 an ounce from seigniorage profit silver. Because the seigniorage silver has already been acquired at no cost to the Treasury, it is all clear profit and the Treasury makes a gain of the full amount, less actual coinage costs, of the subsidiary coinage value on every ounce of seigniorage silver so coined.

Seventy percent of the silver acquired by the Treasury since 1942 is held in bullion form to support silver certificates in circulation. Thirty percent has either gone into the mining of subsidiary coinage or sold for industrial use. No silver dollars have been minted since 1935.

In other words, instead of making 38.79 cents per oz profit under the 1946 Act, the Treasury has made 47.88 cents per oz profit on the overall transaction. This seems ample justification, therefore, for the Treasury to pass on to the domestic silver miners an additional 9.09 cents on all domestically mined silver acquired. This would raise the Treasury price from 90.5 cents to 99.59 cents per oz, a price to which the silver miner is certainly entitled.

It is hoped that the Secretary of the Treasury will decrease the seigniorage by 9.09 cents in partial recognition of the increased costs of mining silver and the base metals with which it is associated in the ores; and to enable the Administration to implement an important phase of its program designed to maintain a mobilization base by aiding certain segments of the domestic mining industry.



In 1955, \$23,000,000 of the \$33,000,000 total silver production was derived as a by-product from lead, zinc and copper operations, illustrating silver's prime importance to the base metal mining industry

THE LIGHT METALS INDUSTRY

By **STANLEY B. WHITE**
Vice-President and General Manager
Metals Division
Kaiser Aluminum & Chemical Corp.

AS of the beginning of 1958, the aluminum industry in the United States finds itself in the interesting and somewhat unusual situation of expanding its overall primary production capacity by some 27 percent, at a cost of something like a billion dollars in new plant facilities, while at the same time, the immediate market demand has actually decreased.

Now even a versatile economist would not be in a position to reconcile this situation without a good deal of background and understanding of the long range aspects of the industry—both its actual past and its calculated future. First, he would need to realize that the light metals are relatively latecomers to our metal culture; they have only recently joined a race that began literally thousands of years ago. There has been no time to waste in catching up; and the fact that primary production of aluminum has doubled since 1951, and has been doubling every ten years since the turn of the century, is certainly evidence that no time has been wasted.

Estimates of aluminum consumption for 1965—and here the writer can speak only of those forecasts which have been made by his own organization—indicate that the total usage of aluminum only some eight years away, will again double. This is a premise generally agreed to within the aluminum industry.

Certainly there will be periods of activity both below and above this indicated long-term rising trend line. Anyone in the basic metals business will understand that. But that this trend will continue, there is never any doubt in the minds of aluminum men. There is implicit faith and understanding within the industry that the unique physical properties and the economic productivity of aluminum, given adequate research, development

Stanley B. White is eminently qualified to author this year's section on light metals. A graduate of Yale University, he received a B.S. degree in metallurgy in 1934. Before joining Kaiser Aluminum in 1947, as rolling mill superintendent at the Trentwood, Wash. Works, he had extensive plant operations experience in both the steel and aluminum industries. In 1950 he

was promoted to plant manager, and soon after was transferred to the company's headquarters in Oakland, Calif., as manager of fabricating plant operations. White was appointed manager of aluminum plant operations in 1953 and was elected a vice-president in 1956.

and sales support, set virtually no limitations on its future markets.

Expansion is Byword of Aluminum Industry

We must, of course, go through a few figures to define the industry quantitatively. As of the middle of 1957, the installed rated reduction capacity of the primary aluminum industry in the United States was 1,775,500 tons annually. Actual production for 1956 was 1,679,431 tons, and total production during 1957 should come to not more than two or three per cent below that figure. With the 762,000 tons of annual primary capacity existing in Canada, the North American aluminum industry has a total production capacity of 2,537,500 tons annually of primary metal, or approximately 70 per cent of the world's supply.

Within the next few months a great deal of new capacity will begin to become effective. In October, our own company started production of a ninth line in the Chalmette reduction plant, adding 27,500 tons of capacity, thus enlarging still further a plant that is already the Nation's largest single aluminum smelter.

The first potline of Kaiser Aluminum's reduction plant at Ravenswood, West Virginia, began to pour metal in November—this plant will ultimately have a capacity of 220,000 tons.

Published information indicates that first operations will commence soon at the following plants of the other companies: the Ohio River plant of Ormet Corporation, jointly owned by Olin Mathieson and Revere, whose total capacity will be 180,000 tons; a 20,000-ton enlargement of Alcoa's Pt. Comfort, Texas, plant; the first line of Reynolds' 112,500-ton addition at Listerhill, Ala. The full capacity of all these new facilities previously



Expansion of facilities such as the Chalmette, La. reduction plant of Kaiser Aluminum gives the aluminum industry a new available capacity of almost 500,000 tons. By 1965 production should exceed 4,000,000 tons—almost double that of 1957

mentioned should become effective before the end of 1958.

By the latter part of 1958, Alcoa should start obtaining metal from the 150,000-ton reduction plant it is building near Evansville, Ind. Harvey is also constructing a 67,000-ton plant at The Dalles, Ore., and Reynolds is in construction on the 100,000-ton plant it is building at Massena, N. Y.

Additional aluminum capacity will also go on stream in Canada in the very near future, with Canadian-British Aluminum, Ltd., starting first operation of its projected 90,000-ton plant at Baie Comeau, Quebec, and Alcan adding a 30,000-ton line at its famous Kitimat plant. In the future Alcan also plans to add 120,000 tons more at Kitimat and another 120,000 tons in the Saguenay area, although that Company has recently announced deferment of part of this work.

Taking in domestic primary production, secondary metal and imports from some foreign countries, principally from Canada, we can expect that the total available supply of aluminum for the year 1957 will wind up in the neighborhood of 2,200,000 tons, very close to the final figure for 1956. Reflecting new available capacity of almost 500,000 tons, the overall supply could amount to 2,700,000 tons in 1958, and by 1965 should exceed 4,000,000 tons.

Swing to Coal for Energy Source

1957 has been a significant year. It is notable in aluminum not only for the immediate relationship of the market to production capacity but also, I believe, for a number of other significant events and situations. One of these is the industry's swing to coal as the energy source for its immense electric power requirements. This move which (may we mention with due modesty) was spearheaded by Kaiser Aluminum in its Ravenswood, W. Va., development. It has tremendous implications not only for our domestic aluminum industry, but also for the electric power generating and distribution industry and, of course, the coal mining and transportation industries. The new efficiencies now available in energy conversion, coupled with plant locations close to markets, and low-cost water-based transport patterns, present an entirely new picture in the economics of aluminum supply as evidenced by the attention which a number of producers are giving to Ohio River Valley facilities.

This move to coal has another value in addition to the economic, and that is the obvious strengthening it affords to the domestic aluminum industry from the point of view of national security.

The year has also seen an unavoidable but moderate increase in the price of aluminum, which took place

last August in the perennial effort to keep the value received for the product in reasonable relationship to the ever-increasing cost of materials and services necessary to manufacture the product. The urgent need to balance increased costs with a price increase was only accentuated by the fact that the move was made in the face of a very competitive market—certainly a most unusual situation.

Magnesium Finds New Markets

But with all this emphasis on aluminum, we must not neglect another important light metal, magnesium.

The history of magnesium in its commercial application parallels in many ways the history of aluminum, particularly in the early-day, up-hill efforts to develop applications and expand markets. Certainly a good deal of this kind of promotional and development effort is going on today and, in fact, will have to go on for a long time to come. Statistics pub-



Mining bauxite in Jamaica, B.W.I.

lished by The Dow Chemical Co. show the relatively recent rise of magnesium from a primary production of only 261 tons in 1928 to 68,347 tons in 1956, amounting to over 40 per cent of the world's production.

Magnesium offers a unique combination of properties of great value to industry for specialized applications. Its outstanding property is its light weight—one-third less than aluminum. Its stiffness-to-weight ratio is very high. It can be cast, rolled, forged, extruded and machined. Its ingot price of 36 cents per lb is reasonable and economic in view of the large volume of the metal in relation to weight. The raw materials for the production of magnesium are literally unlimited, namely sea water and dolomite.

Unlike aluminum, magnesium traditionally and at present ships most of its production for "destructive" uses and, as a result, this portion of production is not recycled. Over half of primary magnesium is used for these purposes. The balance of pri-

mary production is divided about equally between castings and wrought products.

With stockpile requirements completed, magnesium production is on a normal, commercial requirement basis, and showed in 1956 a 12 per cent increase in shipments over 1955.

Bright Future for Light Metals

We can look forward to a consistent growth for magnesium in the years ahead. It is very likely that there is a logical opportunity for additional producers in this field. It will certainly always be an essential material for many critical industrial applications in peace time as well as an indispensable metal to meet military requirements.

As for the future in aluminum, with capacities and production materially ahead of immediate market demands, we have a relatively new freedom and challenge for the further expansion of the market. It has indeed been a long time since a producer could meet a large prospective application for aluminum with anything like complete assurance that the large volumes of metal needed will definitely be available. Only during the past year has this become a fact.

Some of the nation's most important industries—building, transportation and automotive, electrical, packaging and containers, to name only a few—now have under consideration many aluminum product developments and applications which have been presented by members of the aluminum industry. All of these proposals can be considered today from a very practical and immediate standpoint, for the metal to serve these applications is available now and a great deal more is coming along.

Of course we all know, that were only a few of the large volume applications presently under development to materialize, a new pressure for metal would promptly develop. However, the efforts of many hundreds of people and many millions of dollars are being devoted right now to making just that happen.

But here we find the real reason behind the industry's great facility expansion program, with many units under construction and shaping up to produce within the coming year. When the new large volume applications come to pass, the aluminum industry will be ready with the metal.

With recent technological advances and their application all along the line—in exploration, mining, transport, refining, reduction and fabrication—we can look forward in the future to even more efficient integration and coordination of all the stages of production, from the mine to the final sale and application of metal.

Pennsylvania Anthracite in 1957

Mild weather was largely responsible for decreased anthracite sales in 1957 as compared with 1956. Development of new markets and promising research, particularly in the field of metallurgical uses for anthracite, give the industry renewed hope for 1958

By FRANK W. EARNEST, JR.
President, Anthracite Institute

COMMERCIAL production of all sizes of anthracite, including non-union production but excluding colliery fuel and dredge coal, will approximate 23,900,000 tons in 1957, representing a decrease of 11.2 per cent or 3,000,000 tons from 1956 production figures.

While a sizeable part of this loss must be attributed to the attrition of competitive fuels, other large parts of the decrease have been due to the considerably milder weather experienced in 1957 as compared with 1956 and general economic conditions. When it is considered that approximately 70 per cent of anthracite consumption is for space-heating purposes and is, therefore, closely responsive to weather conditions, it will be appreciated how important seasonable weather is to the anthracite industry.

Mild weather in 1957, not only in the northeastern United States, the industry's primary market, but also in its secondary markets, southeastern Canada and western Europe, dealt body blows to anthracite sales. For example, degree days in six key cities of the anthracite primary marketing area have averaged eight per cent less in 1957 than in 1956. This degree day deficiency, along with similar deficiencies in Canada and western Europe, has been very largely responsible for decreased anthracite sales in 1957, particularly in the domestic heating sizes.

Anthracite overseas exports will be approximately ten per cent less than the 2,900,000 tons delivered in 1956. Under more nearly normal conditions, it is likely that 1957 shipments would have exceeded those of 1956.

Research Programs

An examination of the potentialities for increasing Pennsylvania anthracites' markets abroad has been conducted during 1957 under the auspices of the Coal Research Board of the Commonwealth of Pennsylvania. This project has been part of a large research program being sponsored by that agency. The act-

ual work of conducting the investigation of western European markets for Pennsylvania anthracite was delegated to the Anthracite Institute by the Coal Research Board. The Institute's consulting engineer has made extensive investigations and contacts in France, Belgium, Luxembourg, Holland, Spain, Western Germany and Italy, which have been helpful in the furtherance of exports to those countries.

The Coal Research Board's research program in connection with basic and applied research on anthracite is also under way. Much of this work is being conducted by the College of Mineral Industries of the Pennsylvania State University.

Research on anthracite also continues at the United States Bureau of Mines Anthracite Experiment Station, Schuylkill Haven, Pa. Here, encouraging progress has been made on the metallurgical uses of anthracite.

Metallurgical Market May Increase

The metallurgical market for anthracite is a realization in the sintering, taconite and coke manufacturing fields, and a promising potential in others.

In the sintering field, large but as yet undetermined quantities of anthracite are being used. Furthermore, the American Iron and Steel Institute estimates that the nation's sintering capacity will exceed 60 mil-

lion tons annually by the end of 1958, and will have expanded more than 50 per cent in three years' time. This indicates that the potential sinter fuel market will shortly approximate 3,000,000 tons.

The use of anthracite for the pelletizing of taconite also continues as a sizable market. A recent survey of the situation shows that advances in the efficiency of anthracite in the beneficiation of taconite ore have further established it as a preferred fuel in this market.

The sale of anthracite in 1957 to the manufacturers of coke ran seven per cent ahead of 1956 sales. This market is likely to continue its steady growth.

Two other promising metallurgical markets for anthracite lie in steel blast furnace and foundry cupolas. Anthracite, which was once the preferred fuel for blast furnace and cupola work, may be on the threshold of re-entrance into both markets. It is entirely conceivable that 1958 may mark some important steps in the re-entry of anthracite into the steel and foundry industries.

In the meantime, applied research on the use of anthracite in both fields continues at the Anthracite Experiment Station of the U. S. Bureau of Mines, so that efficient methods of using anthracite will be ready whenever the predicted shortage of presently used metallurgical fuels becomes more acute.

The Bureau also conducted full scale gasification tests on Pennsylvania anthracite in Lurgi process equipment in Dorsten, Germany, during 1957. The data developed will be useful in readying anthracite gasification techniques for the synthesis fuel program, which fuel experts predict must ultimately come about to augment the nation's dwindling supplies of liquid and gaseous fuels.

The Anthracite Information Bureau, sponsored jointly by anthracite producers and retailers, is now in its fifth year of promoting anthracite and anthracite heating equipment. This organization is advancing consumer acceptance of heating with anthracite, both by publicity and engineering services.

A thorough analysis of all the factors affecting anthracite sales indicates that shipments to the space-heating markets in the United States and Canada since the advent of the current heating season on September 1, have not kept pace with estimated consumption. This points to the possibility of a delayed buying situation. The freeing of this pent-up demand situation could give the industry better working time and higher production during the early months of 1958 than was the case during the same period of 1957, when warm weather seriously curtailed demand.

Frank W. Earnest, Jr. started his business career in 1919 as assistant purchasing agent for Lycoming Motors Corp., Williamsport, Pa. In



1924 he was transferred to the Spencer Heater Co., a division of Lycoming Motors, and moved from assistant treasurer to advertising manager and then to sales manager. He was vice-president of Spencer Heater from 1928 to 1938.

Earnest entered the anthracite industry in 1936 and has been president of Anthracite Institute since that time. He also serves on many industry committees and boards and is the liaison officer between operators and the United Mine Workers on the Production Control Plan.

If western Europe and Canada should simultaneously experience normal weather, further pluses would be added to anthracite demand.

Contributes One Half Billion Dollars Annually to Nation's Economy

It may be timely to remind those interested in anthracite affairs, that the anthracite industry is still a large one with an annual production valued at approximately a quarter of a billion dollars at the mines, with over 30,000 men directly employed by the industry and many thousands more

indirectly employed through supplying industries and the transportation and retail sales of anthracite. Anthracite's annual freight bill to the nation's railroads is in the neighborhood of \$75,000,000. Adding up all these factors results in an industry that is contributing approximately half a billion dollars annually to the nation's economy.

As we face 1958, we can confidently predict that the non-space heating uses of anthracite will continue to grow, particularly in the metallurgical fuel field. Granted favorable weather conditions, 1958 consumption

of anthracite as a space-heating fuel should exceed that of 1957. While the vagaries of weather are unpredictable, it does seem contrary to the laws of probability for mild weather to occur simultaneously in all three of anthracite's marketing areas—northeastern United States, southeastern Canada and western Europe for a second consecutive year. Therefore, with the single assumption of favorable weather, the prediction may be made that 1958 will see somewhat higher anthracite consumption and production and hence better working time than was the case in 1957.

PHOSPHATE

(Continued from page 107)

co-operative fertilizer plants in the midwest to assist in the ever growing demand for high analysis fertilizers.

The Tennessee District

Monsanto Chemical Co., Victor Chemical Works and Shea Chemical Co. are in actively operating electric furnaces manufacturing elemental phosphorus in the area of Columbia, Tenn. Victor and Monsanto are mining a good portion of their own phosphate but all three are getting rock from small producers.

Virginia-Carolina Chemical Co. continues mining to supply its fertilizer plant at Mt. Pleasant and also to produce phosphate rock for direct application to the soil.

International Minerals & Chemical

Corp., the only other large producer operating in this area, is producing rock for direct application at its plant near Pulaski, Tenn., in addition to mining and washing phosphate rock for electric furnace feed.

Tennessee Valley Authority is continuing test work on the development of methods for the recovery of fluorine evolved in the processing of phosphate rock. A 76 percent P_2O_5 phosphoric acid is produced which, when acidulated with phosphate rock, produced a 54 percent P_2O_5 multiple superphosphate. Other experiments included liquid fertilizers, nitric and potassium phosphates. Florida rock is blended with rock from the Knob Creek area in Maury County, Tenn., for electric furnace feed. The TVA is erecting a demonstration unit at Muscle Shoals, Ala., where Florida phosphate will be processed for fertilizer. This layer of leached zone material,

averaging about five ft in thickness, lies on top of the phosphate matrix formation. It carries a larger percentage of uranium than the pebble matrix below. Other research is carried on by the larger mining companies on many and varied projects—among them more efficient beneficiation in both wet and dry methods, and the recovery of fluorine.

Exporting of phosphate rock continued with substantial movements to South America, the European countries and Japan with about 2,200,000 long tons being shipped during the year.

About 1,000,000 net tons of phosphate were used in 1957 for direct application to the soil. Unless the Federal farm program is changed, this tonnage will remain the same for the coming year. Several new areas in the South and East are showing more interest in this type of fertilizer.

COAL RESEARCH

(Continued from page 114)

(physics and petrology) was dedicated near the end of the year and a second building (chemistry) will follow this year. Mining research will continue according to lines followed during the last few years. A new branch for research on mine ventilation has been set up.

Attempts were made to extend the number and amount of weakly caking coals that can be used in the coking-coal mix as well as to improve the homogeneity of the mix. A full-scale coking research plant will be built in connection with the enlargement of an existing coking plant. Bulk weights as affected by size consist, moisture content, and the addition of small quantities of oil have been investigated.

Work continued on the dust problem in underground workings, on the development of instrumentation, and on routine investigations. The petrology department of the St.B.V. has resumed its research on the structure of briquettes and on the effect of the type and distribution of pitch used as a binder. Two theses were completed

on the subject of inner surfaces of coal by the gas adsorption and by the mercury penetration method, and one on the identification of coal seams. Work on improved coal preparation and its supervision, partly by means of mobile laboratory, and the use of chemicals to increase the efficiency of washeries and flotation plants was carried on.

A more intensive effort was made to determine the behavior of coal minerals during combustion and gasification. Several new types of furnaces were used in these studies, including combustion in a fluidized bed, and the use of air preheated up to 570°F with reduced oxygen content in a traveling-grate furnace. The sintering of fly ash in a sintering machine or a shaft furnace has been recommended as a solution of the fly-ash problem when fusion of the coal minerals is not practicable. High and low-temperature corrosion problems were studied, especially in connection with slagging furnaces.

South Africa

At the National Mechanical Engineering Research Institute of the South African Council for Scientific

and Industrial Research in Pretoria, work is under way on the possibility of using local coal in an internal combustion gas turbine. A combustion chamber with accompanying coal handling and feeding apparatus provides products of combustion for an ash separator and then a cascade tunnel in which erosion and deposition on various blade profiles can be studied.

It was found that fluidizing columns were quite suitable for feeding the coal at rates above 300 lb per hour, but not for rates between 20 and 60 lb per hr. For low rates, a toothed rotor-type feeder and a vibratory feeder are being developed. Investigations were also started to study the combustion characteristics of coal/air mixtures. The immediate intent is to determine the effect of air preheat, particle size, and oxygen concentration on the flame speed. The effect of a resonant field on the rate of flame propagation will also be studied.

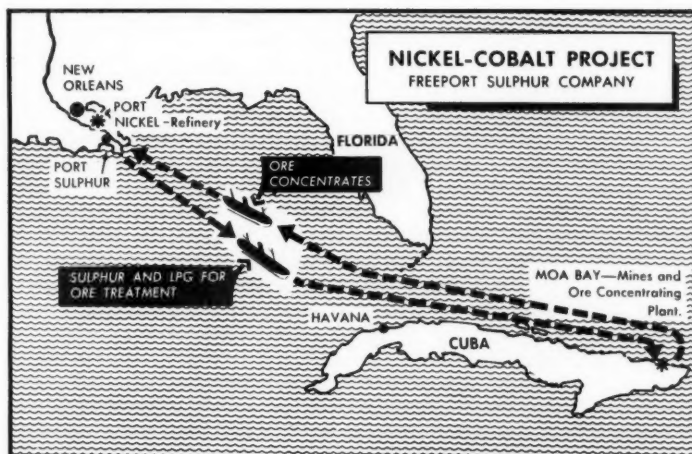
The Fuel Research Institute, Lynnwood Road, Pretoria, is working on coal technology and coal handling in general. They have recently completed a large experimental coal preparation plant.

Cessation of Government stockpiling puts nickel supplies in balance with demand at last. This, along with new sources of supply in Cuba and Canada, points to greater competition in the future among the producers of this extraordinary metal

Nickel: A Key Year

By LANGBOURNE M. WILLIAMS

President,
Freeport Sulphur Co.



Nickel-cobalt ferry will carry ore concentrates in slurry form from Moa Bay to refinery at Port Nickel, La., returning with liquid sulphur and liquid petroleum gas for use in the Cuban concentrating plant. Conversion of vessel will be undertaken by States Marine Corp. for Cuban American Nickel Co., subsidiary of Freeport Sulphur Co.

FOR many years, the demand for nickel has exceeded the supply. The task of filling this demand has become increasingly vital to the free world because nickel is indispensable as a bulwark against corrosion, extreme temperatures, high pressures, impact, and other severe conditions imposed by today's scientific progress. Alloyed with other elements, nickel takes enormous punishment in jet engines, in atomic reactors, in gas turbines, in chemical processing equipment, in marine propellers. It strengthens steel for heavy wear in earth-moving equipment, railroad rolling stock, trucks and buses, farm machinery. As a principal alloying element in stainless steels, it is used in everything from pots and pans to building exteriors.

Though the extraordinary properties of nickel make it indispensable in a great many applications, particularly for defense, engineers have been obliged by the shortage to minimize the use of it wherever possible—sometimes at a considerable compromise with quality. This accounts for the fact that, despite nickel's importance, per capita consumption in the United States has shown no real increase since 1940.

Gov't Stockpiling Stopped

The shortage of nickel persisted throughout most of 1957 although in the latter part of the year the situation improved. This catching up of supply with demand resulted primarily from the diversion to industry of nickel scheduled for addition to the

U. S. Government stockpile. The diversion of some of the nickel intended for stockpiling was started early in 1955, but not until 1957 did the Government release the full quota. Had the amount scheduled for the stockpile been actually taken, there would have been a reported 117,000,000 pounds less for industry. Also contributing to the improved supply-demand situation were declines in consumption in some fields and a gain in nickel production.

World nickel production increased from 456,000,000 pounds in 1956 to an estimated 485,000,000 pounds in 1957. Of the 1957 total, an estimated 365,000,000 pounds came from Canada, some 50,000,000 pounds from New Caledonia, 44,000,000 pounds from Cuba, 18,000,000 pounds from the United States, and 8,000,000 pounds from the Union of South Africa and various other sources.

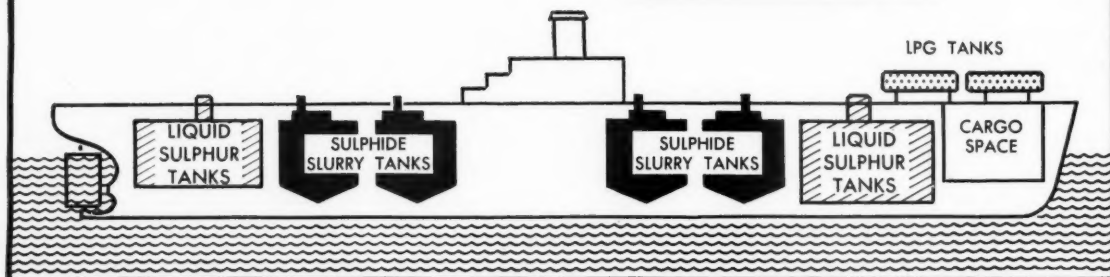
In announcing in October, 1956 that no nickel would be stockpiled for the first quarter of 1957, Arthur S. Fleming, then director of defense mobilization, pointed out that this meant that the Government would not be in the market for nickel for the first time since the Korean War. He explained that, in making the decision not to stockpile nickel, he was counting heavily on getting additional capacity for the production of nickel, and he added that active negotiations to this end were being conducted at General Services Administration. He noted that stockpile requirements could be dropped five pounds for each new pound of capacity expected.

The Moa Bay Project

The agreement which GSA did conclude provided for a project whereby 50,000,000 pounds of nickel annually would be obtained from ore deposits at Moa Bay in Cuba. This agreement, between GSA and Cuban American Nickel Co., a subsidiary of Freeport Sulphur Co., was signed in March, and the Office of Defense Mobilization announced in June that the nickel expansion goal had been met. The ODM action closing the goal was concurred in by the Department of the Interior and the Department of Commerce.

The emergence of Cuban nickel is of particular interest to this country, because our traditional reliance on Canada—and particularly on the International Nickel Co.—has obvious strategic disadvantages in time of war. Most importantly, the advent of

FIRST ORE "TANKER"



First ore "tanker" will be a converted cargo vessel equipped with rubber-lined tanks to carry nickel-cobalt slurry from Cuban concentrating plant to U. S. refinery. Agitators will keep mixture in pumpable form for unloading at conclusion of voyage. On return trip, liquid sulphur will be transported to concentrating plant in heated, insulated tanks. Facilities for liquid petroleum gas, also used in concentrating of ore, will be provided on deck

a new competitive source should have a generally stimulating effect on the metal's growth, much as it did in the case of aluminum after World War II.

Since the project at Moa Bay represents an important "breakthrough" in the development of Cuba's great potential—marking the first time that nickel and cobalt will have been recovered separately as metals from her nickeliferous laterite ores—a brief progress report on this undertaking may be in order.

The orebodies are located at Moa Bay on the Northeastern Coast of Cuba about 450 miles from Havana. Ore reserves which are fully developed total more than 50,000,000 tons averaging about 1.35 percent nickel with cobalt in the ratio of 1 to 10 relative to the nickel. Principal constituent of the ore is iron, running about 46 percent. These reserves assure a substantial life for large-scale commercial nickel-cobalt operations, and if ores containing slightly smaller percentages of nickel are included, proven reserves are considerably increased.

Processing of the ores will involve acid leaching to extract nickel and cobalt, followed by precipitation of metallic values as a sulphide concentrate and the ultimate extraction of nickel and cobalt metals by selective hydrogen reduction of sulphate solutions.

Shortly after mid-1957, arrangements for financing the \$119,000,000 project were concluded, construction of mining and concentrating facilities was begun at Moa Bay and dredging of a ship channel completed. Ground was also broken at Port Nickel, Louisiana, where the refinery will be located. To link the mining and refining operations, a vessel will be converted for trans-Caribbean shuttle service.

This vessel will be unique in the mining industry, and very likely unique in maritime circles as well. The end-product of the ore processing plant at Moa Bay will be a nickel-cobalt concentrate in the form of a slurry which will be pumped aboard the vessel and held in rubber-lined tanks during the voyage north. Prior

to docking at Port Nickel on the Mississippi River, mechanical agitators associated with each tank will prepare the slurry for pumping ashore to the refinery. On the return trip to Moa, other tanks on the vessel will transport hot liquid sulphur and liquid petroleum gas, which are essential to the ore-treating process but unavailable in Cuba.

An extremely important "by-product" of the Moa Bay project is, of course, its contributions to Cuba. Just as the nickel industry has done a great deal for the industrial development and general prosperity of Canada, so nickel will help Cuba to reduce her traditional dependence on sugar cane and bring nearer the day when other minerals may be economically recovered from her lateritic ores, including iron and chromium.

A Look at Nickel's Markets

For Cuban and other expanding nickel sources, there are many expanding markets. One of the most promising is in stainless steel and other alloys for aircraft and missiles. Some forecasters expect this to be the top market for stainless within the next five years. In supersonic aircraft such as the B-58 bomber, chromium-nickel stainless in the form of a honeycomb structure sandwiched be-

tween two sheets of the same material is used to resist heat generated by the friction of air against the skin—heat which at Mach 4 may reach a searing 1000°F. This application is of course in addition to nickel's growing role in jet engines—for tail pipes, afterburners, turbine blades and other high temperature components.

Among missiles, the Snark and Bomarc are already carrying nickel aloft, the Bomarc having an all-stainless fuselage. And it is likely that intercontinental ballistic missiles which must re-enter the atmosphere at tremendous speeds may require some form of nickel-bearing alloy to protect warheads and instrumentation.

With the advent of Sputnik, it is difficult to see any let-up in the aircraft and missile program for defense. Similarly, with the launching of the *Lenin*, first atomic-powered surface ship, it is difficult to see any let-up in our program to float an atomic marine task force. The submarines *Seawolf*, *Nautilus* and *Skate* are already at sea—and the *Seawolf* alone is reported to contain more than 300 tons of nickel-bearing stainless steel. Our first nuclear merchant ship, the *N.S. Savannah*, is being built, and an aircraft carrier and destroyer are under development.

In reactor vessels, coolant systems, control elements and structural parts, the power plants of such a fleet will call upon the corrosion and heat resistance of nickel-bearing alloys. So too, will atomic plants on land, of which the first full-scale commercial example has already been fired up at Shippingport, Pa., to generate electric power. It has been said that a modest-sized nuclear power station would use upwards of 100 tons of nickel-bearing stainless steel, to say nothing of non-ferrous alloys of higher nickel content. And, while widespread use of atomic power may be many years away, there are more immediate possibilities for it in remote areas where conventional forms of fuel could be introduced only at very great expense.

Another important market for nickel alloys and stainless steel would be

(Continued on page 129)

Langbourn M. Williams is president and chairman of the board of Freeport Sulphur Co. He is also president of Cuban American Nickel Co., a Freeport subsidiary, and of Moa Bay Mining Co., a Cuban American subsidiary. A director of B. F. Goodrich Co., he is a trustee and former chairman of the National Industrial Conference Board, and a member of the Council on Foreign Relations.



Prior to the current development of Cuban nickel-cobalt ores by Cuban American and Moa Bay Mining, Mr. Williams' company, through another subsidiary, designed, built and operated for the U. S. Government the nickel plant at Nicaro, Cuba, during World War II.

The Strategic Metals

The strategic metals industry will not survive unless a realistic import control policy is adopted that will, in effect, narrow the gap between high domestic and low foreign production costs

By S. H. WILLISTON

Vice-President
Cordero Mining Co.

STRATEGIC metals are strategic, not because they are obtainable only from outside the country, but because they can be mined more cheaply in foreign countries. To mine many of the strategic minerals, such as beryl and mica, requires extensive amounts of hand labor and those countries which have cheap labor are the world's suppliers.

The situation facing all of the strategic metals is similar to that now facing copper, lead and zinc. Over the last 17 years we have lost 50 percent of the United States market to foreign producers. Now that stockpiles are filled, foreign excess imports, encouraged by our own Government, are threatening to take over the balance of the American market. Furthermore, without some form of import control, they will probably do it.

The only two ways the strategic metals industry can continue to survive in this country is either by outright government subsidies, which Congress will not approve, or by import control which, to date, neither the Administration nor Congress is enthusiastic about. It is gratifying to note, however, that the governors of the western states all feel that the latter policy is not only desirable, but a necessity.

It would seem that the wheel has turned the full 360 degrees and the strategic metals industry is almost back in the position it was in prior to World War II—the forgotten child.

Antimony

The only domestic supply of antimony is a small amount which has to be separated from silver-antimony ores of the Sunshine Mine in Idaho as a by-product. Ninety-five percent of our requirements of antimony are imported from Mexico, Bolivia and South Africa. Two-thirds of this

comes from overseas and would not be available in times of emergency. Tariff protection on antimony is in the neighborhood of five percent on metal and the ore has none.

The federal long-range program says, "No special program is justified for antimony."

It is most amusing to note that Chinese antimony and Russian antimony are now invading the market at cut-rate prices and there is every possibility that they will force the price down to such levels that not even Mexico, Bolivia nor South Africa can compete. We will then be entirely dependent on iron curtain countries for our antimony. Under present Government policies there is absolutely no future for the antimony industry in the United States.

Asbestos

Strategic asbestos, the low iron, long fiber chrysotile, is found in Arizona. This industry was shut down for a three month period when appropriations failed under Public Law No. 733. The industry resumed activities July 1, but has a certain future which will not extend beyond June 30, 1958.

The hopes of this industry lie in the possible establishment of a mill which will process the lower grades now being discarded. Secretary of the Interior Seaton has mentioned the possibility of financial assistance for such a mill through the Department of Interior's Indian Industrial Program. Producers feel there are several uses for which Arizona fiber is best, and research will discover others. One of the most hopeful factors is Arizona's favorable location regarding increased West Coast consumption.

Chrome

Chrome mining under the present General Services Administration purchase plan is nearly at an end. It is not a question of the termination date of June 30, 1959, but when the 200,000 long-ton quota will be filled. Present estimates are that the quota

will be completed sometime around the middle of 1958. Production in recent years has been about 35,000 tons. This will be lessened in the coming year as the chrome miners fear they will be caught in the same position as the tungsten miners found themselves—with ore to sell and no place to sell it profitably.

The proposed long-range minerals policy of the Department of the Interior offered little more to the chrome miner than freight cost from the West Coast to the East Coast, where the bulk of chrome is used. The market price of foreign chrome and sales difficulties would make it impossible for the small independent western chrome miner to operate under the proposed plan. Unless a more realistic attitude is adopted by the Government, domestic chrome mining will be killed off—except in situations where there are individual special contracts, such as the one in effect on Montana chrome.

Cobalt

Production of cobalt within the United States could, according to industry, supply about 40 percent of domestic requirements.

At the present time domestic producers are under contract to the Government, but some of these contracts have only a relatively short period to run. Cobalt has no tariff, and world prices have been reduced to below domestic costs within the last year. A tariff on an ad valorem basis, less than that currently proposed for lead and zinc, could preserve a major part of the industry.

Cobalt was not included in the Department of Interior's program on minerals policy. Producers interpret this as a preference by the government for foreign rather than domestic supply.

Columbium-Tantalum

Columbium and tantalum are two of the metals with great possibilities for high temperature use. They face the regrettable situation that industry will not design them into high temperature products because of the negligible world supply, and miners cannot produce them because of the negligible market. It is, candidly, a question of which comes first—the chicken or the egg. Until that problem is solved the industry is in the doldrums. There is no tariff on columbium-tantalum ores, although there is very adequate protection for the manufactured products.

At the present time there is only one mine operating in the United States whose principal product is columbium-tantalum concentrates. This mine produces 99 percent of this country's total production. Until this mine went into operation 99.9 percent of this country's consumption of columbium-tantalum was imported, princi-

pally from Nigeria and the Belgian Congo.

Further development of a domestic columbium-tantalum mining industry is presently at a standstill because the Government is neither giving recognition to it nor offering any assistance through the several agencies concerned with the various products to be derived from domestic mining operations. There are many potential operations on properties which could be developed if a sound federal program was in effect. It is believed that 50 percent of this country's total requirements could be produced domestically under such a program.

The national minerals program for columbium-tantalum, as set out in Senate Bill No. 2375, provides for a maximum subsidy of \$11,750 per producer. The current market price, plus the subsidy, would indicate that the largest producer eligible would have a gross sales per year of \$17,500. Furthermore, not over five such operations would be possible. Industry estimates indicate that this government program could maintain a columbium-tantalum industry employing only 10 men.

Thorium

At the present time the market for thorium, like that for uranium, is solely the Government; yet there is no program for the purchase of thorium comparable to the uranium program. Thus, a potential thorium producer in the U. S. can sell only to the Government, but the Government will not buy.

While thorium has its limitations insofar as Defense Department requirements are concerned, it has considerable potentialities insofar as power development is concerned. Without question the Government should abandon its present unrealistic policy and either set up a program for the purchase of thorium, or release it from Government control.

Fluorspar

Not many years ago the United States was entirely self-sufficient in the production of fluorspar. More recently, excessive imports of fluorspar have been marketed at costs greatly below the domestic cost of production. In 1956, imports were 160 percent of domestic production, and domestic production plus imports were 25 percent above consumption. 1957 figures will be similar. While consumption is increasing and new and larger uses are being developed, foreign material is supplying all the requirements and still providing an excess. The non-captive fluorspar industry could not have survived had it not been for government purchases at prices approximately 10 percent above the world market. However, the duration of this

Once again S. H. Williston has written a timely review of the strategic metal situation. Williston has had long experience in the field of strategic metals. In addition to being executive vice-president and director of the Cordero Mining Co., he is a director of American Mining Congress and chairman of its Strategic Metals Committee. At one time he was chairman of the Alloy Committee, National Minerals Advisory Council and Chairman of the Mercury and Antimony Subcommittee, Non-Ferrous Metals Advisory Committee to the Munitions Board.



chairman of the Alloy Committee, National Minerals Advisory Council and Chairman of the Mercury and Antimony Subcommittee, Non-Ferrous Metals Advisory Committee to the Munitions Board.

program is severely limited and it is questionable whether it will be continued. Unless some sort of import control is provided for the excess of fluorspar, so that the domestic producers can be assured of at least half the market, the future for the non-captive producers is most uncertain.

Manganese

At the present time the Government is purchasing domestic manganese under the car lot program at prices roughly 50 percent above the world market. The program is limited to 28,000,000 long-ton units and at the present rate will terminate prior to January 1, 1960. No long-range program for manganese was suggested in the Department of Interior's minerals policy, so it is assumed that there is no continuation of the car lot program planned by the Government.

Mercury

A look at the balance sheet and the profit and loss statement of the larger domestic producers of quicksilver would appraise the status of the in-

dustry as fairly as any other means. Most of these mines would either show from modest to heavy losses during their last operating year, or would show sizeable investments yet to be returned—and some at current earning rates well below prudent mining investment rates.

Production for the year 1957 will show an increase of about one-third, rising from 24,000 flasks a year to approximately 32,500 flasks. Mexican production has also increased. These production increases, along with a decline in consumption in the latter part of the year and the termination of some government purchases both domestic and foreign, has caused surpluses to appear in the last quarter and the price broke from \$256.00 down to the Government support level. Imports, especially from Mexico and Spain, were in excess of consumption and were the primary cause of the decline.

The high spot of the year involved the confusion over Government specifications for mercury containers in connection with the Government support program. The original specifications put out 3½ years ago were confusing, and one member of the industry offered material to clarify the confusion and to make sure the Government would buy mercury at \$225.00 a flask. No objection was raised to ordinary flasks of the trade. In October the Government complained about losses due to leakage which occurred in 1948, although such losses were never reported to the Quicksilver Advisory Committee of the (old) Munitions Board. In November new flask specifications came out which, in effect, approved only flasks made by a single California producer. When it came to light that these flasks had a weld at the top, a longitudinal weld from top to bottom and another weld at the bottom, the



The American miner is accustomed to a high standard of living and demands a high wage for his services. Consequently, in this country, it is uneconomical to process strategic metals requiring extensive hand labor. (Pictured above is the swimming pool at the New Cornelia Branch of Phelps Dodge Corp. in Ajo, Ariz.)

whole problem of flask specifications was turned over to the Stanford Research Institute.

Although technically no flasks were acceptable by the government during Nov. and Dec., the Government waived the seamless specification and as the year closed, seamless Old Spanish and Old Italian bottles were acceptable as well as longitudinally welded California flasks. But, bottles of similar manufacture from Spain and Yugoslavia were still on the condemned list. Since domestic producers were unable to obtain specification flasks in which to ship mercury under the 1957 procurement program to the General Services Administration by Dec. 31, the expiration date of that program, GSA issued an order permitting domestic producers to tender offers of mercury by Dec. 31 and make shipments in acceptable flasks up to Mar. 31, 1958.

As the year ended, domestic consumption plus imports was well in excess of domestic consumption and the market continued weak.

It is most unfortunate that government policy over the last 14 years has directed the purchase of all stockpile materials from foreign sources. Domestic producers have not even been allowed the opportunity to bid on government requirements.

Rare Earths

There are large high grade reserves of the rare earths within this country, yet American industry is using almost exclusively imported material—largely from Africa and South America, coming in by way of the barter system. The long term solution would seem to be import control of some sort, either quota or tariffs—preferably the latter.

In addition to the fundamental problem of foreign competition, continued research for improved technology and investigation of new uses is still very important. Until these steps are taken the domestic future for the ample proven supply of domestic rare earths is uncertain.

Tin

Tin is truly a strategic material. There are no promising occurrences of tin known in the United States—only small amounts of by-product metal being produced currently. There is, however, one possession of the United States where tin is known to occur and which has been incompletely explored, i.e., Alaska. Engineers familiar with Alaska feel there are distinct possibilities, and that the situation justifies a rather extensive study by the U. S. Geological Survey and Bureau of Mines, and possibly some sort of a subsidy. Such a pro-

gram might develop a source for tin under conditions of national emergency.

Tungsten

The tungsten situation is well known. In 1950 when the Korean War started, the tungsten situation was acute. The Defense Department was forced to economize on the use of tungsten to such an extent that it materially affected the defense program. The industry was encouraged to expand, and reached a point where it was able to supply twice the peacetime consumption and slightly over one-third of the estimated 1951 wartime requirements. Although legislation was passed to continue the program, the failure of Congress to make the appropriations provided for in the law almost completely shut down production in the United States. Now, we are once more dependent on foreign sources.

The outlook for the strategic metal industry is bleak. The National Minerals Policy so long awaited has contributed little if anything to the general situation. The conclusion remains that for most mining people engaged in the strategic metals industry, as well as in the critical metals, the alternative to going broke is to go foreign.

NICKEL: A KEY YEAR

(Continued from page 126)

created by the coming of the gas turbine engine in automobiles. Experimental models have used the metal extensively in engine parts which may be exposed to high-pressure air at 1500°F and rotational forces up to 50,000 rpm. Some predictions place 1965 automobile production in the range of 8,000,000 to 10,000,000 cars and, if by then or in subsequent years the turbine gains any significant share

of the market, nickel use by the automobile industry could climb sharply.

There are many other areas for potential growth: nickel-bearing stainless steel for curtain-wall construction of multi-story buildings, for versatile tank-truck fleets, for kitchen utensils and home appliances, for bulk handling of milk from cow to consumer; nickel-bearing electrical alloys for a growing power industry, increasing automation and instrumentation, and other electronic applications; corrosion-heat- and pressure-resistant al-

loys for the expanding chemical and petrochemical industries.

In sum we have, on the one hand, a stepped-up defense program of which the end is nowhere in sight. We have, on the other, a legion of civilian industries which now can see an increased supply of nickel ahead. Under these circumstances, the expanding and increasingly competitive nickel industry should look to the future with confidence that the demand for this metal will continue to grow.



Ship channel and turning basin to serve the nickel-cobalt project at Moa Bay, Cuba, as viewed from Vigia Hill, where a town will be constructed



Liner castings used in ball-mill discharge launders at Climax are made of Alloy 321. This grade of white iron alloy, first publicized in 1957, effectively combats the severe wear which occurs as a result of erosion from the coarse pulp discharge

Molybdenum

By J. Z. BRIGGS
Director of Technical Information
Climax Molybdenum Company

Decrease in steel production in 1957 caused a slight excess of moly supply over demand, but an orderly development of new applications and improved alloy steels using molybdenum point to continued long range growth of the molybdenum industry

FOR the molybdenum industry, the year 1957 marked a shift from an almost balanced supply and demand, to a small excess of production. Production in the free world increased to an estimated 65,000,000 pounds of molybdenum, as compared to about 62,000,000 in 1956; of the 1957 production, 60,000,000 pounds were mined in the United States, and only about 5,000,000 originated elsewhere.

As in the past, the production at Climax, Colo., amounted to about two-thirds of the total molybdenum production. The Climax mine is now the largest underground mine in the world, with an output of some 35,000 tons of ore a day; the 100,000,000th ton of ore was removed from this mine during 1957. The balance of the free-world molybdenum production was largely a byproduct of copper mining.

Strikes and Stockpiles

Three events of importance during the year were the release of 1,100,000 pounds of molybdenum from the British stockpile, cancellation by Climax of its government contract for low-grade ore, and a five-month strike at Climax's Langeloth refinery. The cancellation of the low-grade contract makes the Climax production picture more flexible as the mine is no longer compelled to include a certain amount of low-grade ore in its

output. The five-month strike at the Langeloth refinery complicated the supply picture in the second half, but the situation was eased by getting alternate facilities into production. The strike was settled towards the end of the year, and technical molybdenic oxide was in normal production at the end of 1957.

Reflecting increased demand from the nuclear-energy and missile fields the production capacity of molybdenum metal by the vacuum-arc consumable-electrode method was considerably greater at the end of 1957 than at the start. The original pro-

ducer added a larger furnace to its equipment, and a second source established melting facilities and made preliminary pilot runs. Still greater capacity is now being engineered.

Consumption and Outlook

Consumption of molybdenum dropped slightly to about 60,000,000 pounds of molybdenum in 1957 in the free world. On a geographic basis, about 34,500,000 pounds were used in the United States with the rest abroad. Consumption of other major industrial countries was 7,300,000 pounds in Great Britain and 5,700,000 in Germany, while France approached 4,000,000. As compared to the previous year, British, French and German consumption increased moderately; and United States dropped somewhat.

1958 Predictions

Predictions for 1958 are that production and consumption will remain fairly constant. Demands outside the United States have remained at a high level and are expected to do so in 1958 unless there is a radical change in the economy. American consumption tapered off towards the end of 1957 as a result of the drop in steel production. An evaluation of these varying trends indicates no great change in 1958.

(Continued on page 132)

J. Z. Briggs received her S.B. degree in Engineering from Stanford University and was later awarded an Engineering



degree in Mining at the same school. Finding jobs for women miners difficult to obtain in the depression years, she went to Europe for further study and earned her Doctorate of Mining Sciences at Leoben Mining Institute, Leoben, Austria. Her professional work has been predominantly in metallurgy, having spent ten years working on high-quality steels at the Crucible Steel Co. of America and continuing in similar work with Climax for the past 13 years. Recently she has concentrated on the development of art-cast molybdenum for possible applications in the missile field.

Titanium

By GLOYD M. WILES

Manager, Mining Dept.
National Lead Co.

The pigment industry remains the principle market for ilmenite and rutile producers. Titanium metal production decreased in 1957, resulting in a marked decline in the output and price of rutile. Exploration for new mineral deposits continued

ALTHOUGH titanium is ranked as the ninth most abundant element, only two minerals, ilmenite and rutile, are minerals of commerce. Rutile occurs principally in beach sands along with varying quantities of ilmenite, zircon, monazite, and various "heavy" silicates, all usually derived from weathering of igneous rocks forming older highlands. The major ilmenite occurrences are beach placers wherein the ilmenite predominates, and in igneous rocks associated with anorthosite or gabbroic rocks. Of the current world production of ilmenite, approximately half comes from hard rock deposits in which ilmenite is associated with hematite or magnetite.

Rutile is used principally for production of metal because of its high TiO_2 content and because it can be reacted directly with chlorine to make titanium tetrachloride from which titanium sponge is reduced by reaction with magnesium or sodium. Rutile is also used for welding rod coatings, in ceramics, and, in small quantities for alloys and chemicals.

Ilmenite is world-wide in occurrence and because about 98 percent of all ilmenite produced is used in the titanium pigment industry, one important measure of the worth of a deposit is its proximity to, or ease of transportation of its product to a pigment plant. The titanium pigment industry in the United States has enjoyed a steady growth which has, in turn, brought about the three fold increase in ilmenite consumption since 1942.

From 1947 to 1957 pigment production is estimated to have increased by more than 100 percent. The properties of titanium dioxide pigments which have brought about their steadily widening spectrum of uses include chemical inertness, opacity or hiding power, and low specific gravity.

Titanium Metal Output Down

Domestic production of ilmenite and rutile for use in pigment manufacture, ferro-titanium alloys, welding rod coatings, and minor other uses has continued at a high level as evidenced by expansion of existing producers and the introduction of new sources of production. In addition, the search for new titanium mineral occurrences in the United States has been carried on at an unprecedented rate.

A decrease in United States titanium metal production rate has resulted in a marked decline in the rutile output in Australia, and a decline in price quotations from $9\frac{1}{2}$ to $11\frac{1}{2}$ cents per pound in January, 1957, to 6 to $6\frac{1}{4}$ cents in January, 1958.

Canadian output, in the form of titanium slag, continued to increase as additional furnaces are being added at the Sorel plant of Quebec Iron and Titanium.

Elsewhere in the world, in Norway, India, Malaya, Finland, Egypt, Spain, Portugal, Japan, and Australia output of ilmenite concentrates was maintained at normal or slightly expanded levels.

World production of ilmenite during 1957 is estimated to be about 1,925,000 tons. This includes all classes of ilmenite and slag.

ESTIMATED WORLD ILMENITE PRODUCTION, 1957

United States	700,000 long tons
Canada	250,000
Europe	300,000
India	300,000
West. Australia	100,000
Malaya	75,000
Japan	150,000
Other, World	50,000
	1,925,000 long tons



Huge rotary kilns perform a necessary step in the production of titanium oxide pigments at the Sayerville, N. J., plant of National Lead Co.

It is estimated that world ilmenite production capacity should exceed 2,000,000 tons within a year or so as new facilities in the building and planning stages come into operation. In the United States, National Lead Co. completed a 25 percent increase in concentrate capacity at its Tahawus, New York, operation. Metal and Thermit has recently completed an ilmenite-rutile plant in Hanover County, Va., which will produce both ilmenite and rutile; output of the latter is scheduled at 5000 tons per year. In the southeastern Coastal Plain new developments are in the early stages on Cumberland Island, Georgia, by the Glidden Co., and on nearby Amelia Island by Union Carbide Ore Co.

Foreign Producers Active

At Umgababa, Natal, Union of South Africa, Umgababa Minerals, Ltd., an associate of Anglo-American Corp. is expected soon to be producing ilmenite at a rate of 100,000 tons per year. Also in Africa, British Titan Products is bringing its Gambia plant

Gloyd M. Wiles received his mining education at the University of California. After graduation he worked in several positions with



Granby Consolidated Mining, Smelting and Power Co. in British Columbia; with the Bunker Hill metallurgical staff at Kellogg, Idaho; with Treadwell Yukon Co., Ltd. at Bradley, Ontario, and with Sudbury Diamond Drilling Co. throughout the eastern provinces of Canada. After returning to this country, he was employed by the John Hays Hammond interests as field engineer, and later became vice-president and general manager with Park City Consolidated Mines Co. in Utah. Since 1942 Wiles has been with National Lead Co. as general superintendent of the company's operations at Baxter Springs, Kans., as manager at Tahawus, N. Y., and in his present position as manager of the mining department with headquarters in New York City.

into production, at about 40,000 tons of ilmenite per year. In Western Aus-

tralia a 100,000-ton per year plant is expected to reach production soon. Norway's production of ilmenite is expected to be increased in the near future as newer deposits are brought into operation.

Exploration for new sources of ilmenite and rutile in the United States has been maintained at a brisk rate, particularly in the unconsolidated Coastal Plain sediments. In New Jersey disclosure by the State of an ilmenite occurrence in Ocean County led to intensive prospecting campaigns.

Canada's first pigment plant went into operation late in 1957. Canadian Titanium Pigments, Ltd., a subsidiary of National Lead Co., built the plant at Varennes, Quebec, to produce both anatase and rutile types of pigment from Sorel slag.

Evidence of the general interest in all aspects of the titanium industry was exhibited by publication by the U. S. Bureau of Mines of Information Circular 7791 "Titanium—a Materials Survey" by Jesse A. Miller.

MOLYBDENUM

(Continued from page 130)

Applications

Metallurgical and chemical applications of molybdenum developed in an orderly fashion during the year with no startling innovations.

An interesting development was the increasing consumption of super-strength structural steels, which have minimum yield strengths of 55,000 to 150,000 psi as compared to 50,000 psi for high-strength low-alloy steels and about 32,000 for carbon structural steels. Of the 15 grades available commercially today, all but two contain molybdenum in amounts up to 0.5 percent and molybdenum is added to one of these two in heavier gages. In addition to their high strength, these steels have other advantages such as corrosion and wear resistance, which make them suitable for uses such as dipper sticks, mine cars, skip hoists, ore chute liners and similar applications in the mining field and elsewhere.

Two new wear-resistant grades of iron were publicized for the first time in 1957. Alloy 321 is a white iron containing about three percent Ni, two percent Cr and one percent Mo, which has better wear resistance than similar alloys not containing molybdenum. This composition is well suited for heavy-section castings and abrasion-resistant castings of the martensitic white-iron type for parts such as some types of ball-mill liners. The other material, Alloy 42, is an abrasion-resistant martensitic white iron, which has shown an excellent com-

bination of abrasion resistance and toughness combined with corrosion resistance. It contains approximately 3.2 percent C, 16.5 percent Cr and three percent Mo and appears to be most suited for parts such as sand pumps, flotation impellers, pug mill blades and sand classifier wear shoes.

Chemical uses are increasing steadily, with moly sulfide finding more and more applications as a lubricant. Dur-

ing 1957, a number of major oil companies introduced branded industrial and automotive greases containing moly sulfide as an additive. Research and development work is continuing on new molybdenum chemicals, such as the heteropolymolybdates, which appear to have commercial potentialities in applications such as extraction of heavy metals from classifier slimes and similar mineral dressing liquors.



Interior view of 13 by 12-ft ball mill at Climax, showing shell and discharge end liners, which were made from type 2 martensitic chrome-moly steel with about five percent molybdenum. Note the spiral wear pattern on end liners, which are almost worn out. Rotation of mill is counterclockwise

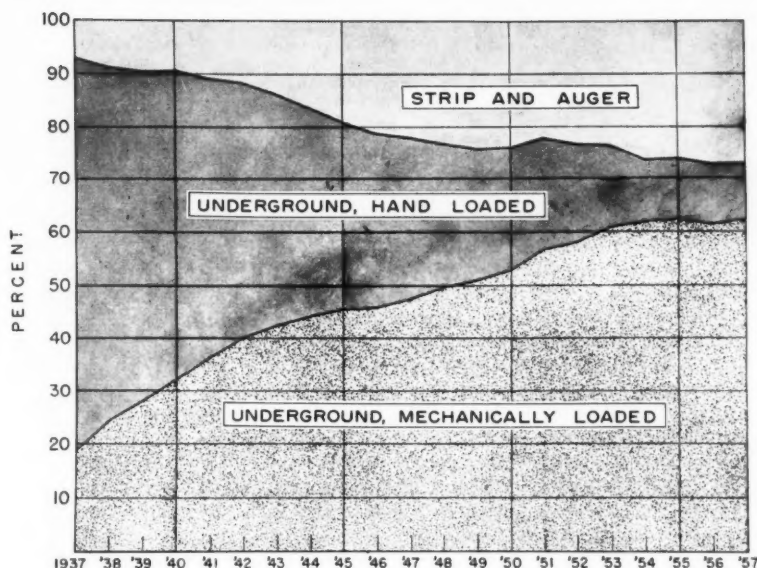


Figure 1—PERCENTAGE OF TOTAL PRODUCTION OF BITUMINOUS COAL AND LIGNITE IN THE U.S., 1937-57 BY TYPE OF MINING AND LOADING

Sales of Coal-Mine Equipment

Mechanized 1957 saw 89 percent of the total output of bituminous coal and lignite mechanically loaded at underground mines, loaded by power shovels at strip mines or mined by augers along highwalls in strip mines

By W. H. YOUNG and R. L. ANDERSON

Respectively
Chief, Bituminous Coal and Lignite Section, and
Supervisory Commodity-Industry Analyst, U. S. Bureau of Mines

SHIPMENTS of mechanical loading equipment for underground use in coal mines in the United States, in terms of capacity, registered practically no change in 1957 from 1956. The capacity of mechanical cleaning equipment sold for use at bituminous coal mines was 12 percent greater in 1957 than in 1956. Shipments of mobile loading machines, coal recovery augers, shuttle cars, room or transfer conveyors, and bridge conveyors decreased while continuous mining machines and "mother" conveyors increased in 1957 from 1956.

This survey was made possible by the cooperation of all known manufacturers of mechanical cleaning equipment for bituminous-coal mines and of mechanical loading and supplementary haulage equipment and coal-recovery augers for use in all coal mines in the United States. Data from various trade journals were also utilized.

Mechanical loading units, coal-recovery augers, and supplementary haulage equipment sales in 1957, as in previous years, represent shipments made during the year. Of the total capacity of mechanical cleaning equipment sold in 1957, 31 percent was placed in operation during that year; the remainder (69 percent) will be installed later.

Mechanical Loading and Mining

Bituminous coal and lignite mechanically loaded in underground mines decreased from 307 million tons in 1956 to an estimated 305 million tons in 1957. Production at strip mines decreased from 127 million tons to an estimated 122 million tons, and auger mine production increased from 8 to 10 million tons during the same period.

Table 1 shows data on bituminous coal and lignite production, by methods of mining, and mechanical cleaning for 1955-57, inclusive. Percentage of total production of bituminous coal and lignite in the United States, 1937-57, by type of mining and loading is shown on figure 1. The percentage of total output mechanically loaded and cleaned increased in 1957 over 1956. During 1957, 89 percent of the total output was mechanically loaded at underground mines, loaded by power shovels at strip mines, or

Table 1.—Bituminous-coal and lignite production, by methods of mining and by mechanical cleaning, in the United States, 1955-57, inclusive

	1955		1956		1957 ¹	
	Thousand net tons	Percent of total	Thousand net tons	Percent of total	Thousand net tons	Percent of total
Hand-loaded underground	52,794	11.4	58,372	11.6	53,000	10.8
Mechanically loaded underground	290,671	62.5	307,402	61.4	305,000	62.3
Mined at auger mines	6,075	1.3	8,045	1.6	10,000	2.0
Mined by stripping	115,093	24.8	127,055	25.4	122,000	24.9
Total production	464,633	100.0	500,874	100.0	490,000	100.0
Mechanically cleaned	272,715	58.7	292,365	58.4	290,000	59.2

¹ Preliminary.

Table 2—Underground bituminous-coal and lignite production, by methods of loading, 1955-57, inclusive

	1955		1956		1957 ¹	
	Thousand net tons	Percent of total	Thousand net tons	Percent of total	Thousand net tons	Percent of total
Mobile loading machines:						
Loading direct into mine cars	47,397	13.8	35,428	9.7	(²)	(²)
Loading onto conveyors	12,505	3.6	14,069	3.8	(²)	(²)
Loading into shuttle cars	183,303	53.4	198,844	54.3	(²)	(²)
Continuous mining machines	27,460	8.0	39,907	10.9	(²)	(²)
Scrapers	140	...	156	...	(²)	(²)
Conveyors equipped with duckbills or other self-loading heads	4,369	1.3	3,727	1.0	(²)	(²)
Hand-loaded conveyors	15,497	4.5	15,271	4.3	(²)	(²)
Total mechanically loaded	290,671	84.6	307,402	84.0	305,000	85.2
Hand-loaded into mine cars	52,794	15.4	58,372	16.0	53,000	14.8
Total underground production	343,465	100.0	365,774	100.0	358,000	100.0

¹ Preliminary.² Included with "Total mechanically loaded."

mined by augers along highwalls in strip mines.

Underground production of bituminous coal and lignite, by methods of loading, is listed in table 2. Although the percentage of underground production mechanically loaded registered a slight decline in 1956 from 1955, it is estimated that in 1957, it will be higher than in any previous year.

Auger Mining. Augers are used for coal recovery along highwalls in strip mines and on bench operations where coal cannot be economically mined by stripping. Separate data on the number of augers in use and the tonnage produced by auger mining were first collected for 1952.

Reports from four manufacturers of coal-recovery augers show that 55 augers were shipped in 1957 compared with 89 in 1956, a decrease of 38 percent. All augers shipped in 1957 were for surface use except the two shipped to anthracite mines for underground use. Table 3 shows coal-recovery auger shipments in 1953-57, and table 5, the number in use in 1956 and shipments in 1957, by states.

Types of units sold. Table 3 lists the units of mechanical loading and mining equipment shipped for use at coal mines in the United States, 1953-57, inclusive. Shipments of continuous mining machines and "mother" conveyors increased in 1957 from 1956, all other types of mechanical loading and mining equipment listed on table 3 decreased in 1957 from 1956 except scrapers, which had no shipments in either year.

Exports of underground mechanical-loading equipment in 1957, in terms of capacity, amounted to 15 percent of the shipments to mines in the United States compared with 14 percent in 1956.

Types of mechanical-loading equipment sold compared with units in use. Table 4 shows the trend in demand for various types of mechanical-loading equipment. Continuous mining machines were first used in 1948; however, the number in use was not shown separately until 1952. The number in use has increased every year from

Table 3—Units of mechanical loading and mining equipment sold for use in coal mines as reported by manufacturers, 1953-57, inclusive

Type of equipment	1953	1954	1955	1956	1957	Change from 1956 (percent)
Bituminous-coal and lignite mines:						
Mobile loading machines	180	92	120	239	209	— 12.6
Continuous mining machines	67	101	109	154	168	+ 9.1
Coal-recovery augers	57	55	65	89	53	— 40.4
Scrapers ²	11	5	...	...	...	...
Shuttle cars	437	242	348	560	488	— 12.9
"Mother" conveyors ³	58	19	78	137	172	+ 25.5
Room or transfer conveyors ⁴	87	61	143	232	159	— 31.5
Bridge conveyors	(5)	(5)	(5)	128	96	— 25.0
Anthracite mines (Pennsylvania):						
Mobile loading machines	1	17	1	1	1	...
Continuous mining machines	...	1	...	...	1	...
Coal-recovery augers	...	...	1	...	2	...
Scrapers ²	3	...	2	...	...	...
Shuttle cars	...	14	8	2	2	...
"Mother" conveyors ³	...	...	3	...	2	...
Room or transfer conveyors ⁴	16	24	7	19	45	+136.8
Bridge conveyors	(5)	(5)	(5)	...	1	...
Number of manufacturers reporting	25	23	22	22	21	...

¹ Revised.² Reported as scrapers or scraper haulers and hoists.³ Includes all haulage conveyors with a capacity over 500 ft, except main slope conveyors.⁴ Includes all haulage conveyors with a capacity of 100 ft to 500 ft, except main slope conveyors.⁵ Not available.

Table 4—Sales of mechanical loading equipment in 1957 compared with machines in use in preceding years

	Number of machines in use, as reported by mine operators					Number of Machines sold as reported by manufacturers in 1957
	1952	1953	1954	1955	1956	
Bituminous-coal and lignite mines:						
Mobile loading machines	4,083	3,985	4,314	3,819	3,854	209
Continuous mining machines	152	219	325	385	510	168
Scrapers	19	29	48	23	35	...
Conveyors equipped with duckbills or other self-loading heads	1,049	849	633	487	437	(1)
Hand-loaded room conveyors, number of units	3,569	2,994	2,162	1,925	1,819	159
Anthracite mines (Pennsylvania):						
Mobile loading machines	54	39	68	79	80	1
Continuous mining machines	...	...	...	...	...	1
Scrapers	456	489	359	279	303	...
Hand-loaded room conveyors, number of units ²	3,232	2,784	2,277	1,940	1,593	45

¹ Sales of conveyors equipped with duckbills or other self-loading heads are included with hand-loaded room conveyors.² Includes pit-car loaders and conveyors equipped with duckbills or other self-loading heads.

W. H. Young and R. L. Anderson need no introduction. Their reports on equipment sales have been used as a yardstick by the coal industry for many years. We



W. H. Young



R. L. Anderson

are proud to once again present their annual review.

Dr. Young joined the U. S. Bureau of Mines as an economist in the Coal Economics Division. Since 1944 he has served as chief of the Bituminous Coal Section.

After working with a firm of consulting mining engineers R. L. Anderson joined the Government in 1934. Since that time he has been employed by various agencies having to do with coal and at the present time is a commodity-industry analyst with the Bureau.

1952 to 1956. Shipments of continuous mining machines in 1957 were 33 percent of the number in use in 1956 at both bituminous coal and lignite mines and Pennsylvania anthracite mines. Mobile loading machine shipments in 1957 were five percent of the number in use in 1956.

Table 5 shows the number of mechanical loading units and coal-recovery augers shipped to various states in 1957 compared with the number in use in 1956, as reported by mine operators. Sales of room conveyors as listed in table 5 are not exactly com-

Table 6—Units of conveying equipment sold for use in coal mines, 1956-57, by states

State	Bridge conveyors		Shuttle cars		"Mother" conveyors ¹	
	1956	1957	1956 ²	1957	1956	1957
Bituminous-coal and lignite mines:						
Alabama	6	7	33	49	7	2
Colorado	4	4	4	5	1	2
Illinois	4	4	9	4	12	6
Indiana	4	4	8	3	1	1
Kentucky	30	16	35	30	6	15
New Mexico	4	4	2	2	9	16
Ohio	10	10	10	10	9	16
Oklahoma	12	14	130	99	36	40
Pennsylvania	12	14	130	99	36	40
Tennessee	4	4	2	2	1	1
Utah	3	7	8	30	4	5
Virginia	3	7	40	21	7	9
West Virginia	63	51	275	241	53	73
Wyoming	4	4	2	2	9	16
Total bituminous-coal and lignite	128	96	560	488	137	172
Anthracite mines (Pennsylvania)	1	2	2	2	2	2
Grand total	128	97	562	490	137	174

¹ Includes all gathering and haulage conveyors with capacity over 500 ft. except main slope conveyors.

² Revised.

parable with the number of room conveyors in use. To avoid duplication in tonnage mechanically loaded, each operator was instructed to report "hand-loaded" and "self-loading" conveyor tonnage only; therefore, conveyors loaded by mobile loading machines and continuous mining machines are not included with "Room conveyors in use in 1956." Shipments of coal-recovery augers in 1957 were 19 percent of total number in use in 1956.

Haulage Equipment

Shuttle cars. Sales of shuttle cars decreased from 562 in 1956 to 490 in 1957. Details of shipments to various states in 1956 and 1957 are given in table 6.

Exports of shuttle cars in 1957 in-

creased approximately 75 percent over 1956. Units exported in 1957 amounted to approximately 28 percent of the 1957 sales in the United States.

"Mother" conveyors. For the purpose of this study "mother" conveyors include sectional, extensible, power-driven gathering and haulage conveyor units that can handle over 500 ft of conveyor. Main-slope conveyors are excluded. Table 3 lists sales for 1953-57, inclusive, and table 6 shows shipments by states in 1956 and 1957. Exports of "mother" conveyors in 1957 were approximately one percent of the sales in the United States.

Bridge conveyors. Sales of bridge conveyors decreased from 128 in 1956 to 97 in 1957 or 24 percent. Shipments by states are listed on table 6.

Table 5—Mechanical loading and mining equipment in use in 1956, by states, compared with sales reported in 1957

State	Mobile loading machines		Continuous mining machines		Scrapers		Room conveyors ¹		Coal-recovery augers	
	In use in 1956	Sales in 1957	In use in 1956	Sales in 1957	In use in 1956	Sales in 1957	In use in 1956	Sales in 1957	In use in 1956	Sales in 1957
Bituminous-coal and lignite mines:										
Alabama	115	7	10	7	13	13	84	11	1	1
Alaska	6	1	2	2	13	13	11	1	1	1
Arkansas	47	1	1	1	6	6	25	1	1	1
Colorado	200	1	35	3	6	6	157	1	1	1
Illinois	70	3	3	2	6	6	8	1	1	1
Indiana	4	17	16	12	6	6	179	20	44	16
Iowa	532	17	16	12	6	6	15	1	1	1
Kentucky	4	1	1	1	6	6	7	1	1	1
Maryland	16	1	1	1	6	6	1	1	1	1
Missouri	2	1	1	1	6	6	1	1	1	1
Montana, bituminous	2	1	1	1	6	6	1	1	1	1
New Mexico	3	1	1	1	6	6	1	1	1	1
North Dakota and Montana, lignite	141	23	8	8	6	6	37	47	7	7
Ohio	5	1	1	1	6	6	80	1	1	1
Oklahoma	843	30	248	50	3	3	552	28	33	7
Pennsylvania	44	7	1	1	6	6	41	2	13	1
Tennessee	131	14	12	6	6	6	14	1	1	1
Utah	187	14	11	11	6	6	33	5	26	5
Virginia	4	1	1	1	6	6	32	1	1	1
Washington	1,471	115	135	57	6	6	867	102	124	16
West Virginia	33	2	2	2	6	6	113	1	1	1
Wyoming	3,854	209	510	168	35	35	2,256	159	288	53
Total bituminous coal and lignite	80	1	1	1	303	303	21,593	45	(3)	2
Anthracite mines (Pennsylvania)	3,934	210	510	169	338	338	3,849	204	288	55
Grand total	3,934	210	510	169	338	338	3,849	204	288	55

¹ Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads.

² Also includes pit-car loaders.

³ Data not available.

Mechanical Cleaning

Reports from 21 manufacturers of bituminous coal-cleaning equipment show that the total capacity of 1957 sales was 13,225 net tons of clean coal per hour compared with 11,810 tons of capacity sold in 1956, an increase of 12 percent. Sales in 1957, by type of equipment, in terms of capacity, show that dense medium ranked first, followed by jigs and wet tables. The capacity of all types of equipment sold in 1957 for cleaning bituminous coal by wet methods was equivalent to seven percent of the bituminous coal cleaned by wet methods in 1956, and the capacity of pneumatic equipment sold in 1957 was six percent of the tonnage pneumatically cleaned in 1956. Approximately 64 percent of the total capacity of cleaning equipment sold in 1957 was for additions to present installations and the remainder, 36 percent, comprised new plants.

Table 7 gives data on bituminous coal cleaned in 1956, and the annual capacity of equipment sold in 1957, by states.

Table 7—Bituminous coal mechanically cleaned in 1956, compared with sales of mechanical cleaning equipment in 1957, by states
1956

State	Number of plants in operation	Net tons of cleaned coal	Output mechanically cleaned (percent)	Annual capacity of equipment sold in 1957 (net tons) ¹
Alabama	32	11,306,990	89.3	(2)
Alaska	4	341,486	47.0	
Arkansas	(3)	(3)	(3)	
Colorado	34	31,312,764	337.5	30,000
Illinois	61	41,396,985	86.1	412,000
Indiana	23	12,310,515	72.0	2,022,000
Kansas	3	611,136	69.1	
Kentucky	84	41,708,504	55.9	2,129,000
Missouri	11	3,072,313	93.6	
Montana	2	12,315	1.5	
New Mexico	1	32,775	20.7	120,000
Ohio	26	17,059,794	43.8	(2)
Oklahoma	3	553,333	27.6	
Pennsylvania	100	54,845,125	60.7	1,415,000
Tennessee	4	1,001,992	11.3	
Utah	4	3,333,135	51.1	(2)
Virginia	27	12,132,408	43.2	3,736,000
Washington	5	457,956	96.9	
West Virginia	188	90,862,855	58.3	9,219,000
Wyoming	1	13,003	.5	120,000
Undistributed				608,000
Total	583	292,365,384	58.4	19,811,000

¹ Based on average days mines were active in 1956 and 7.0 hours per day.

² Included in "Undistributed."

³ Arkansas included with Colorado.

INDUSTRIAL MINERALS

(Continued from page 103)

um ores from rock deposits was also important. Titania A/S in Norway was going ahead with its plant and quarry for its large deposit found at Telnes a year ago, and is building a mill to treat 3100 tpd to be in production by 1960.

In Canada, Quebec Iron and Titanium Corp. is expanding its furnaces at Sorel. Continental Iron and Titanium Mining, Ltd., which operates at Baie St. Paul, has plans to build a plant

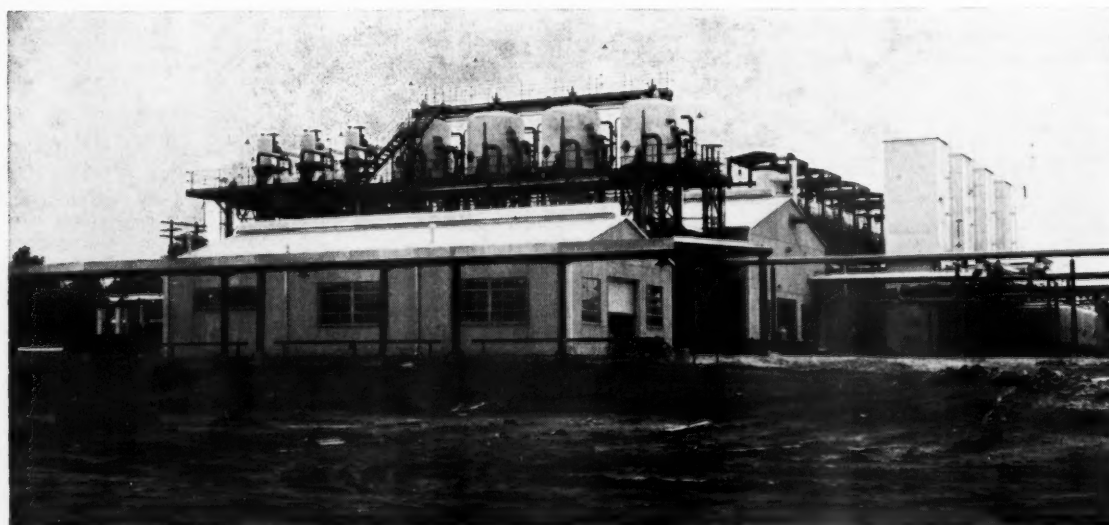
for production of artificial rutile by pressure leaching of ilmenite concentrate. Tamara Mining, Ltd., in the Ste. Marguerite area, 40 miles north of Montreal, has developed 5,500,000 tons of ore with an average grade, in the ground, of 17 percent TiO_2 .

In Oaxaca, Mexico, Compania Minera Tisur, S. A., a subsidiary of the Republic Steel Co., has shut down its development and exploration program in the rutile deposit near Pluma Hidalgo because of the slump in the rutile demand.

ZIRCON AND ZIRCONIUM COM-

POUNDS—Most of the news in zirconium was concerned with the production of the metal, which is not pertinent to this review. The export of zircon from Australia continued at a high rate during the year. The slump in the demand for rutile, because of the slump in the demand for titanium metal, has put many of the Australian miners of beach sands out of business, as most of them cannot continue profitably with the sale of zircon alone.

In this country, Florida operators ran at almost full capacity during the year. The principal demand for zircon is as a foundry sand.



Texas Gulf Sulphur Co. completed construction of a new Frasch process plant at its Fannett Dome in Jefferson County, Tex., designed to heat 2,000,000 gallons of water per day



Cincinnati in the spring—a view from the Kentucky side of the Ohio River

1958 Coal Convention

Cincinnati — May 5-7

miss this big event, which promises to be another gala affair designed to satisfy the appetites of convention visitors for food, frolic and fun.

Tuesday night will be left open, offering a fine opportunity to look up old friends, make new ones, go "room-hopping" or just sit around and visit.

The customary banquet will climax the Convention on Wednesday evening. This will again be a "speechless" affair, with only brief introductions of honored guests followed by another top-notch program of "name" entertainment.

"Research for Progress" Is Theme of Industry's Annual Meeting

When the 1958 Coal Convention of the American Mining Congress convenes in Cincinnati, Ohio, next May 5-7, leaders in all phases of coal mining will be on hand to discuss the latest developments in their highly mechanized industry.

Under the chairmanship of James C. Gray, vice-president-operations-coal, U. S. Steel Corp., the National Program Committee has developed one of the finest programs ever to be presented to the industry. It covers all aspects of modern underground and strip mining operations, coal preparation, mine safety, maintenance, power, etc., with acknowledged experts participating in each session.

The theme of the Convention is "Research for Progress." This thought is woven through the program, with many of the papers based on actual research aimed at improv-

ing mining operations, cutting costs, and producing a higher quality product.

A look at the preliminary program, on the following pages, will reveal that the Convention discussions will deal with topics currently uppermost in the minds of coal mining men everywhere.

UMWA Leader to Speak

A particularly significant feature of the program will be a luncheon on Monday, May 5, at which John L. Lewis, president of the United Mine Workers of America, will be the guest speaker. He will be introduced by George M. Humphrey, chairman of the National Steel Corp. and former Secretary of the Treasury. This will represent one of the rare appearances of Mr. Lewis before an industry group. The UMWA executive has been an ardent advocate of mine mechanization and his cooperation in the development of mechanized mining has contributed greatly towards the efficiency of the industry.

At a luncheon on Tuesday, attention will be focused on another celebrity in his own right. Bob Feller, the one-time Iowa farm boy who rewrote the record book as far as major league baseball pitchers are concerned, will take the mind of Convention goers off serious business for a while with a look into the player's side of baseball.

Entertainment Plans

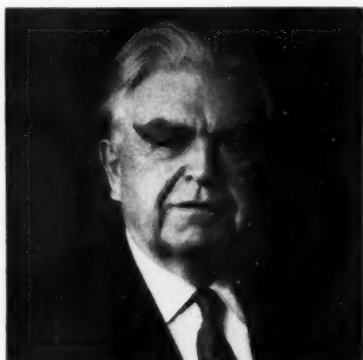
The traditional Coal Miners Party will be held Monday evening, May 5 at the beautiful Castle Farm pavilion in Cincinnati. No one will want to

Women's Program

The men folks are beginning to realize that their women are a pretty important part of their business, and an outstanding program is being planned for the ladies who will accompany their husbands to Cincinnati. Special luncheons and entertainment, along with browsing in the many fine shops in Cincinnati, will keep the women busy while their men are occupied with business at the meeting.

All indications point to a record-breaking Cincinnati convention. Those who have not already done so are advised to make reservations as soon as possible by writing directly to their favorite hotel in Cincinnati. If assistance in securing accommodations is desired, contact the Cincinnati Convention & Visitors Bureau, Inc., Union Central Bldg., Cincinnati, Ohio.

TURN TO THE FOLLOWING TWO PAGES FOR THE CONVENTION PROGRAM.



John L. Lewis will address the American Mining Congress at a special luncheon on Monday, May 5...



... He will be introduced by George M. Humphrey, former Secretary of the Treasury

Preliminary Program

Monday, May 5

10:00 A.M.—Research for Progress

CHAIRMAN—JAMES C. GRAY, Vice-President—Operations-Coal, U. S. Steel Corp.

Humanizing Research

DR. W. H. ALEXANDER, Pastor, First Christian Church of Oklahoma City

Research in the Coal Industry

DR. A. A. POTTER, President, Bituminous Coal Research, Inc.

12:15 P.M.—Luncheon Address

Guest Speaker—JOHN L. LEWIS
President, United Mine Workers of America

Mr. Lewis will be introduced by
GEORGE M. HUMPHREY, Chairman,
National Steel Corp.

2:15 P.M.—Strip Mining

CHAIRMAN—R. J. HEPBURN, Vice-President, The United Electric Coal Companies

Two Seam Stripping and Parting Removal

FRANK GILBERT, Superintendent, River Queen Mine, Peabody Coal Co.

Current Practices in Anthracite Stripping

A. E. CODDINGTON, Engineer, Carey Baxter & Kennedy

Discussion:

JAMES R. BAZLEY, Vice-President, J. R. Bazley, Inc.

Developments in Ammonium Nitrate Blasting

Speakers from two midwest coal stripping companies.

2:15 P.M.—Underground Power

CHAIRMAN—GEORGE L. JUDY, Vice-President, Consolidation Coal Co. (W.Va.) Division of Pittsburgh Consolidation Coal Co.

Factors in Evaluating and Selecting A-C Power Systems for Underground Coal Mining

RAY HUFFMAN, Staff Electrical Consultant, Donegan Coal & Coke Co.

Discussion:

DAVID E. HAMILTON, Application Engineer, General Electric Co.

Selection of A-C Distribution Equipment

JOHN STACHURA, General Superintendent, Enoco Collieries

Operating Experience with A-C Mining Equipment

P. W. GALEENER, General Superintendent, Johnstown Coal & Coke Co.

COAL MINERS PARTY

Cincinnati's Famous Castle Farm

Cocktail hour begins at 6:30 P.M., followed by dinner, dancing and entertainment.

Tuesday, May 6

9:30 A.M.—Coal Preparation

CHAIRMAN—WILMOT C. JONES, Vice-President, Jeddoh-Highland Coal Co.

Fine Coal Preparation at Crucible Steel

M. C. CHANG, Research Department, Crucible Steel Co. of America

Benefits of Reducing Circulating Solids

J. J. REILLY, Coal Preparation Superintendent, Vesta-Shannopin Preparation Plant, Jones & Laughlin Steel Corp.

Pumping Coal and Refuse

PAUL LEVIN, Project Engineer, Allen-Garcia Co.

Recent Advances in Coal Thermal Drying

F. R. ZACHAR, Consulting Engineer

9:30 A.M.—Safety

CHAIRMAN—RALPH E. KIRK, Consulting Engineer, Kirk & Cowin

Benefits of Mine Lighting

ROBERT R. GODARD, Electrical Engineer, U. S. Steel Corp.

Experience with Flame Resistant Belting

DONALD SHUPE, Superintendent, Eastern Gas & Fuel Associates

Safety Advantages in the Use of A-C Current Underground

RALPH M. HUNTER, Manager, Electrical & Mechanical Department, Rochester & Pittsburgh Coal Co.

Rock Dusting in Multiple Shift Operations

C. E. LINKOUS, Director of Safety, Island Creek Coal Co.

12:15 P.M.—Luncheon

PRESIDING: JACK H. HOW, President, Western Machinery Co., and Chairman, Manufacturers Division, American Mining Congress

Address: BOB FELLER
All-Time Baseball Great

2:15 P.M.—Haulage

CHAIRMAN—W. A. GALLAGHER, Vice-President, Stone-ga Coke & Coal Co.

Recent Developments in Shuttle Cars

A. L. LEE, Manager, Lee Engineering Division, Pittsburgh Consolidation Coal Co.

Combination Belt and Mine Car Haulage

C. WARD PADGETT, General Superintendent, Southern Illinois Division, Bell & Zoller Coal Co.

Discussion:

E. M. PACE, General Superintendent, Inland Steel Co.

M. H. SHUMATE, Assistant General Manager, West Virginia Division, Truax-Traer Coal Co.

An Operations Research Approach to Mine Haulage

ERNEST KOENIGSBERG, Head, Operations Research Section, Midwest Research Institute

Discussion:

O. D. MCDANIEL, Manager, Industrial Engineering, Old Ben Coal Co.

Tuesday, May 6 (Continued)

2:15 P.M.—Continuous Mining

CHAIRMAN—J. L. HAMILTON, *Executive Vice-President, Island Creek Coal Co.*

Continuous Mining in Thin Seams

W. J. B. MAYO, *Division Manager, Eastern Gas & Fuel Associates*

Performance Standards for Continuous Mining

DONALD C. HOWE, *Industrial Engineer, Jones & Laughlin Steel Corp.*

Maintenance of A-C Continuous Miners

L. T. LINDSAY, *Shop Foreman, Sunnyside Mine, Kaiser Steel Corp.*

Analysis of Service Haulage Behind Continuous Mining Equipment

GERALD VON STROH, *Director of Development Committee, Bituminous Coal Research, Inc.*

Wednesday, May 7

9:30 A.M.—Conventional Mining

CHAIRMAN—OSCAR A. GLAESER, *President, United States Fuel Co.*

Foreman Training

JOHN KAITES, *Industrial Engineer, Berwind-White Coal Mining Co.*

Preventive Maintenance

JOHN HEALEY, *Master Mechanic & Chief Electrician, Elk River Coal & Lumber Co.*

Modern Approach to Equipment Maintenance

RALPH DEAN, *Administrative Assistant, Lorado Coal Mining Co.*

9:30 A.M.—Coal Preparation

CHAIRMAN—R. H. HUGHES, *President, Clinchfield Coal Co.*

Reducing Coal Preparation Costs Through Automation

GEORGE H. MORRIS, *Preparation Engineer, Indiana Division, Peabody Coal Co.*

Advances in the Art of Dense Media Cleaning

EMERY MILLIGAN, *Preparation Manager, Freeman Coal Mining Corp.*

Future Demands in Coal Quality by the Electric Utility Industry

R. H. WOLIN, *Assistant Chief Engineer, Combustion Engineering Co., Inc.*

Research on the Nuclear Irradiation of Coal for Use with Diesel Fuel
RAY MCBRIAN, *Director of Research, Denver & Rio Grande Railroad*

2:00 P.M.—Continuous Mining

CHAIRMAN—P. P. FERRETTI, *Vice-President, Pocahontas Fuel Co., Inc.*

Ventilation Problems in Connection with Continuous Mining Systems

DONALD KINGERY, *Chief, Mine Ventilation Section, U. S. Bureau of Mines*

Roof Support with Continuous Mining Equipment

G. C. DYAR, *General Superintendent of Mines, Alabama By-Products Corp.*

Designing Continuous Mining Systems

JESSE CORE, *General Superintendent, Coal Division, U. S. Steel Corp.*

Russian Developments in Continuous Mining Equipment Design

C. M. MCWHORTER, *Mining Engineer, Goodman Manufacturing Co.*

2:00 P.M.—Strip Mining

CHAIRMAN—S. F. SHERWOOD, *President, Stonefort Corp.*

Continuous Mining in Strip Highwalls

A. D. HENRY, *General Superintendent, The Powhatan Mining Co.*

Developments in Strip Mine Haulage (A Symposium)

ROBERT BUNCH, *Partner, Bunch Construction Co.*

WILLIAM C. LAIDLAW, *Production Engineer, The Enos Coal Mining Co.*

ERNEST W. BRUNS, *President, Bolt Mining Co.*

LOWELL COPELAND, *Vice-President, Cherry Hill Coal & Coke Co.*

Speaker from Midland Electric Co.

7:00 P.M.—Annual Banquet

Brief introductions of honor guests, followed by an outstanding entertainment program.



Progressive mining men are looking forward to the 1958 Coal Convention in Cincinnati, May 5-7



Wheels of GOVERNMENT



As Viewed by HARRY L. MOFFETT of the American Mining Congress

The second session of the 85th Congress, which convened January 7, will be a long and arduous one with adjournment not likely until late in the summer. Seasoned observers point out that it will be one of the most controversial and politically motivated sessions in recent years.

Pervading its discussions and actions in the months ahead will be these major factors—the scientific and military advances made by Russia, the recession in our economy, and the political elections next Fall.

The Administration's legislative program is being outlined in a series of messages. Plans for defense and maintenance of world peace were outlined in the President's State of the Union message; a number of his economic proposals were spelled out in the Budget message; his farm program was set forth in another message, and his further legislative recommendations will be detailed in messages dealing with mutual assistance, labor law revision, defense reorganization, and the veteran's benefits.

With little in the way of organization to attend to, Congressional Committees got off to a flying start. Hearings are either under way or have been held on tax revision, the farm program, the debt ceiling rise, our defense posture, and a number of budget requests for the various agencies of Government.

TRADE ACT EXTENSION UNDER FIRE

One of the biggest battles of the session will rage around the Presidential request for a five-year extension of the Trade Agreements Act with increased authority to cut tariffs. Protectionists and free-traders have plans to parade numerous witnesses before the Committees to buttress their respective views.

The opening gun in the battle will be fired on February 17, when the 25-man House Ways and Means Committee begins hearings on the President's proposals. Sentiment against them runs high, and it was with great difficulty that the Administra-

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Washington Highlights

TRADE ACT EXTENSION: Faces real battle.

TAXES: Reduction unlikely.

LABOR: Regulation of union funds urged.

STOCKPILE: Goals trimmed to three years.

NATURAL GAS: Harris bill faces tough sledding.

BUDGET: Record for peacetime.

COAL RESEARCH AGENCY: Advocated by House members.

★ ★ ★ ★ ★ ★ ★

tion was able to obtain introduction of its bill by a Republican member of the Committee. House Speaker Rayburn (Dem. Tex.) has commented that "blood, sweat and tears" will be needed to get the program through, while House Minority Leader Martin (Rep. Mass.) has declared the program "will have the roughest going in Congress." Representatives Daniel Reed (Rep. N. Y.) and Richard Simpson (Rep. Pa.) have expressed the view that there will be a hard fight to extend it to all, and that it would be well to drop the entire subject and not undertake an extension. These statements reflect the growing demands across the country for protection of domestic industries from foreign imports. Rising unemployment accompanying the slowdown in the economy has affected industry from Maine to California, and has brought about demands for tariff protection for industries ranging from clothespin manufacture to mineral production.

Strong attempts will be made to amend the bill to make Tariff Commission findings under the "peril point" and "escape clause" provisions of the Act subject to Congressional decision rather than that of the

President. At this time there are few who will predict the final outcome of the battle.

Elsewhere in the tariff field, the Tariff Commission is still studying the lead-zinc industry plea for higher duties and quotas but has not yet indicated when a decision may be reached. Similarly, the Commission's study of tungsten production costs at home and abroad as a prelude to tariff rate changes is still going on, with no determinations as yet in sight.

Measures have been introduced in both House and Senate by members of both parties which would amend existing copper import tax legislation to change the present peril point of 24 cents per pound to 30 cents per pound, and to impose a 4-cent-per-pound import tax when the price of copper falls below the 30 cent level for a calendar month. Authors of the bills stated that the domestic copper mining industry has born the brunt of copper production curtailments and that unemployment exists throughout copper-producing areas. They termed the proposals absolutely necessary to enable the U. S. copper industry to survive.

TAX HEARINGS CONCLUDE

By the time this is published, Ways and Means Committee hearings on general revenue revision will have been concluded and the mass of testimony turned over to the staff of the Joint Internal Revenue Committee for sifting, study, and drafting of recommendations for possible legislation.

During the course of the month-long hearings, a large number of witnesses came out strongly for the easing of tax rates, both on individuals and on corporations. These pleas were made in the face of a general feeling that tax cuts are "out the window" in view of the heavy demands for defense expenditures.

Treasury Secretary Anderson called for an extension of existing corporate and excise tax rates but recommended some tax relief for small business. He stated that general tax reductions "do not seem prudent" under current conditions, but did say that the Administration might support tax reductions if the economic slump grew worse.

Chairman Lincoln Arnold of the American Mining Congress Tax Committee urged the Committee to remove roadblocks to needed expenditures for exploration by removing the present \$100,000 per-year ceiling on expensing of such expenditures. He said that these deductions currently are permitted for a four-year period only and that many mining companies are no longer able to deduct any exploration costs. Removal of this restriction, he declared, would permit the industry to step up its exploration efforts, which have been lagging in recent years.

Arnold also called for an increase from 50 to 100 miles in the distance for which transportation costs can be included by mining companies in computing depletion allowances. He asked for a number of important technical revisions, and urged the committee to permit expenditure of funds for air and water pollution abatement facilities to be deducted on a current basis rather than being recovered through depreciation.

The AMC spokesman made a strong plea for an increase in the depletion allowance for coal, stating that more equitable tax treatment would assist the coal industry in securing investment capital required to meet future energy needs.

Another spokesman for the coal industry, Otto Gressens, executive vice president, Peabody Coal Co., urged an increase in the coal depletion allowance from 10 to 15 percent. He also urged that the tax laws be amended to remove the \$1000,000 limitation on deductions for exploration, to simplify the computation of taxable income from the property, and to repeal both the 2 percent tax on the filing of consolidated returns and the tax on incorporate dividends.

Meanwhile, the House is considering the technical tax revision measure reported by the Ways and Means Committee last year.

The President's request for a boost of \$5 billion in the debt ceiling received prompt action. After a one-day hearing the measure was quickly sent to the House floor, where it was overwhelmingly approved.

LABOR LAW REVISION PREDICTED

Chairman McClellan (Dem. Ark.) of the Senate Labor Rackets Committee expects to submit an interim report on the result of the Committee's investigations to date early this year. He has predicted that Congress will approve some of "the new laws that are required."

McClellan has recommended that Congress prescribe basic standards and requirements for the conduct of union affairs; require welfare, pension and union funds to be trust funds; make union officials fully accountable for the handling of union funds in the

same manner as bank managers; and deny tax exemption privileges to any labor organization failing to comply with the standards of conduct and accountability established by law.

Meanwhile a number of bills have been introduced by members of the Senate Committee to correct some of the abuses now prevalent. Senator Ives of New York, vice-chairman and ranking Republican on the Committee, has introduced four bills. One would require the filing of financial and organizational reports by unions with the Secretary of Labor, with penalties for failure to file or filing false information. The second provides for assurance of secrecy in union elections. The third would make it an unfair labor practice for a union to engage in picketing if another union has been certified by the National Labor Relations Board, if the petition seeking certification is pending before the Board, or if within the previous year the employees have voted down the picketing organization. The fourth bill provides that payments by employer agents to individuals or unions to influence decisions would be illegal.

Senator Mundt (Rep., S. Dak.) has introduced bills protecting against the misuse of union funds; assuring secrecy in union elections; denying the use of the Labor Relations Board to unions whose officers have been found guilty of various crimes; making it an unfair labor practice to engage in picketing unless authorized by a certain percentage of the employees involved; and denying income-tax exemption to labor organizations which participate or intervene in political campaigns.

ODM REPORTS ON STOCKPILE

Stockpile objectives on 63 out of 76 strategic and critical materials were reached June 30, 1957, according to the Stockpile Report to Congress filed by Gordon Gray, Director of the Office of Defense Mobilization. One objective, extra long staple cotton, is no longer listed as a stockpile objective.

The 12 materials on which inventories have not been completed include asbestos, amosite; bauxite, metal grade; diamond dies; fluorspar, metallurgical grade; jewel bearings; magnesium; manganese, chemical grade; mica, block; mica, film; platinum group metals, palladium; selenium, and crude silicon carbide.

The report also advised that, in the future, purchases for the strategic stockpile would be based on an anticipated emergency of three years instead of the five-year period previously used as a basis. New procurement will exceed the three-year level only in a very few instances involving maintenance of the domestic production component of the mobilization base.

As this is written the ODM Advisory Committee on stockpiling has not issued its findings, but it is expected they will be released shortly. The report is expected to hold that stockpile goals for most strategic and critical materials are more than sufficient for a three-year emergency.

NATURAL GAS BILL PUSHED

Supporters of the natural gas bill, including House Speaker Sam Rayburn (Dem., Tex.) have predicted action by Congress at this session on the measure if a preliminary "head count" indicates sufficient votes for passage. The bill would substitute a "reasonable market price" criterion for FPC determination of producer prices instead of the current "utility type" criterion. It was approved by the House Interstate and Foreign Commerce Committee last year, but was not brought up for floor consideration because polls taken at the time indicated the bill would not pass. It is believed Rayburn wants early action on the bill, before consumer groups and others have lined up opposition strength in the House.

Amendments which would have prohibited below-cost sales of gas and granted the Federal Power Commission jurisdiction over direct sales by pipelines were offered but defeated in Committee. Similar amendments may be offered on the House floor should the bill get there for consideration.

Most Washington observers are of the opinion that the measure faces tough sledding because of the strong opposition voiced in the past by consumers, as well as by some segments of the oil pipeline industry, and by domestic coal producers.

BUDGET REQUEST SUBMITTED

The \$73.9 billion budget for fiscal 1959 submitted to Congress by President Eisenhower last month emphasized military preparedness, with increased defense outlays partially offset by curtailment of some domestic programs. The fiscal year begins July 1, and subcommittees of the House Appropriations Committee have already started consideration of the funds requests for various departments.

The largest peacetime budget in history shows a slight surplus of \$500 million in anticipated receipts over expenditures. This is based on a continuation of the 52 percent corporate income tax rate as well as current levels of excise taxes, thus dimming any chance for tax cuts this year. The President also asked for a temporary increase of \$5 billion in the debt limit—a request which was promptly approved by the House. He recommended a two-year renewal of the Defense Production Act, extension of the Renegotiation Act, a five-year extension of the Trade Agreements Act, authorization of U. S. participation in

(Continued on page 145)



Personals

Charles R. Kuzell has retired as vice-president in charge of western activities for Phelps Dodge Corp. He has been succeeded in that position by Walter C. Lawson, who has been general manager of Phelps Dodge in the

Anaconda Co. has announced several changes in subsidiary companies.

Herbert M. Weed has been elected vice-president of Anaconda Sales Co. and Anaconda Export Co.

W. E. Kennedy has retired as executive vice-president; Clarence Glass has retired as vice-president, and John A. O'Brien has retired as assistant secretary of Anaconda Sales Co. Ken-



W. C. Lawson



C. R. Kuzell

West. Lawson was also elected a director of the corporation.

Kuzell had been with Phelps Dodge since 1935, having previously held positions with the Anaconda Co. and United Verde Copper Co. He will continue as a director of Phelps Dodge and will also serve in a consulting capacity.

Lawson has had long experience in the management of the Phelps Dodge properties in Arizona. In 1952, after serving as general superintendent of its Morenci branch and as manager of its New Cornelia branch, he was made assistant to the vice-president of the corporation in charge of western activities. He became general manager in 1955.



H. M. Wood



W. E. Kennedy

nedy, Glass and O'Brien have also retired from Anaconda Export Co.

Norbert F. Koepel has been appointed assistant to the vice-president of both Chile Exploration Co. and Andes Copper Mining Co. Glen S. Wyman has been named general manager of both Chile Exploration Co. and Andes Copper Mining Co., and Robert C. Becker has been appointed



C. Glass

resident manager of Chile Exploration Co. at Chuquicamata.



G. E. Morris

George E. Morris, superintendent of Chile Exploration Company's copper smelter at Chuquicamata since 1951, has been named director of metallurgy, The Cananea Consolidated Copper Co., S. A.

R. C. Fish has been appointed vice-president of the M. A. Hanna Co. He has been associated with the Hanna mining operations since 1922. At the same time it was announced that R. W. Whitney had been appointed vice-president for mining operations of the company.

Pharic D. I. Honeyman was recently elected president of Inspiration Consolidated Copper Co. He is a director, and had been vice-president and general manager of the company since 1947. Honeyman succeeds Richard S. Newlin who resigned as president and director. William Wraith, Jr., was elected a director to fill the vacancy left by the resignation of Newlin.



P. D. I. Honeyman

The following changes in the Inspiration management have also been announced: H. Miles Jacob has been elected executive vice-president; H. Carroll Weed has been appointed general manager, and Carl G. Stunz is now assistant general manager of the company's Arizona operations. Edward F. Wendt has been elected secretary-treasurer.

Appointment of Leonard L. Slabodnik as purchasing agent for the Oliver Iron Mining Division, U. S. Steel Corp., has been announced. He succeeds G. A. Engel, retired.

Earl H. Miller and John E. Fletcher have been promoted to vice-presidents of the United States Potash Co., Division of United States Borax & Chemical Corp.



E. H. Miller

Miller, resident manager of the Carlsbad operations of U. S. Potash since 1956, is now vice president and resident manager of the Potash division.

Fletcher, sales manager since 1956, is now vice-president and sales manager of the Potash division.

MCJ Has New Assistant Editor

JOINING the ranks of the staff of Mining Congress Journal as assistant editor is Jerry M. Whiting.



Jerry calls the Northwest his home, having grown up in the Spokane area. He has learned mining from the muck-stick up as a workman and engineer in both underground and open-pit mines. His experience includes: Washington lead-zinc, Utah uranium, Nevada gypsum and Arkansas bauxite operations. Also, the sea is not strange to him since he served two years as a naval officer aboard a destroyer.

Jerry's formal training was received at the College of Mines, University of Idaho, where he received a B.S. and M.S. degree in mining engineering.

We know Jerry's technical training and mining background will be of benefit to our many readers, and we extend him a hearty "Welcome."

Grover J. Holt, general manager of the mining department of the Cleveland-Cliffs Iron Co., has been appointed assistant to the president of Cleveland-Cliffs.

Adolph Seaberg, formerly general foreman of the Hill-Annex iron mine, Minnesota Ore Division of the Jones & Laughlin Steel Corp., has been named superintendent of the Lind-Greenway iron mine.

On January 31, **T. J. Crocker**, manager, Bethlehem Mines Corp., retired following 42 years in the Bethlehem organization. He had been manager of the Bethlehem Mines Corp. since 1950 and is widely known for his activities in coal industry affairs.



John J. Sloan and **Donald J. Doyle, Sr.**, have been made pit foremen at the Plummer and King mines respectively for Oliver Iron Mining Division, U. S. Steel Corp.

Bituminous Research, Inc., has announced the following promotions. **Dr. Harold J. Rose**, is now vice-president and consultant; **J. R. Garvey**, is director of research, and **John W. Iggoe** is director of administration.

— Obituaries —

Erle V. Daveler, 71, mining engineer and corporation executive, died November 11 in his New York home after a brief illness.

Mr. Daveler began his mining career in 1907 with the Tonopah Mining Co. He did research work for Utah Copper Co. from 1909 to 1911, and served as assistant superintendent of mills for Ray Consolidated Copper Co. from 1911 to 1913. For the next five years he was superintendent of mills and assistant manager of Alaska Gold Mines, Inc., following which he joined Butte and Superior Co., serving successively as superintendent, general superintendent, and general manager. In 1930 he became vice-president, treasurer and director of Nevada Consolidated Copper Corp., Utah Copper Co., Gallup-American Coal Co., Bingham and Garfield Railroad, Ray and Gila Valley Railroad, and Nevada Northern Railroad, all predecessor companies of Kennecott Copper Corp., and served as personal representative in New York of D. C. Jackling. In 1943 he left Kennecott to join American Zinc, Lead & Smelting Co. as vice-president and director.

Active in many corporate and industry affairs, Mr. Daveler was also a director of Lone Star Cement Corp., Texas Gulf Sulphur Co., Guardian Life Insurance Co., Cuban Atlantic Sugar Co., Minerals Beneficiation, Inc., and Granite City Steel Co., and was president and later chairman of Mesabi Iron Co. He was a trustee of the Charles Hayden Foundation and had served as a trustee and a member of the Finance Committee of Stevens Institute of Technology.

Mr. Daveler was active in many industry organizations. He served as chairman of the finance committee of

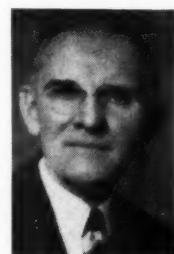


E. V. Daveler

the American Mining Congress from 1934 to 1943, during a critical time in the organization's history. He had also been a member of the board of directors and chairman of the investment committee of the American Institute of Mining and Metallurgical Engineers; president of the Mining and Metallurgical Society of America, and treasurer of the American Zinc Institute. Widely known throughout the industry, he will be sorely missed by his many friends.

Herbert A. Sawin, sales engineer for the Yuba Manufacturing Co., died December 2, after a long illness. Mr. Sawin had been associated with the Yuba Company for 35 years and was widely known and respected in the mining industry.

James D. Francis, 73, former president and board chairman of the Island Creek Coal Co., died in Huntington, W. Va., January 8.



J. D. Francis

A native of Pikeville, Ky., Mr. Francis received a degree from the University of Virginia Law School in 1908 and began the practice of law in Welch, W. Va. He became legal counsel for Island Creek in 1911 and was active in the affairs of this company and its affiliated companies throughout his lifetime. In 1918 he was made vice-president and general counsel of Island Creek and Pond Creek Pocahontas Coal Co., and in 1943 was elected president of both companies. In 1949 he became chairman of the board, retiring from this position in 1952, when he became president of Powellton Coal Co. and board chairman of Princess Elkhorn Coal Co. In 1956 he was made chairman of Powellton Coal Co.

Mr. Francis was one of the outstanding leaders in the coal industry

and was active in its councils throughout his career. He served on the Board of Directors of the American Mining Congress from 1936 to 1949 and as vice-president from 1942 to 1949. He was for many years a director of the National Coal Association, and was one of the founders of the Southern Coal Producers Association. An ardent advocate of orderly marketing in the coal industry, he was largely responsible for the organization of Appalachian Coals, Inc., in 1932. He also served as a director of the Chamber of Commerce of the United States, the National Association of Manufacturers, and the Southern States Industrial Council, and was one of the original members of the Business Advisory Council of the U. S. Department of Commerce.

A man of strong convictions, with an exceptional capacity for organization, and boundless energy, Mr. Francis brought all his remarkable talents to bear in building up the companies which he served, and in advancing the welfare of the entire coal industry. He was keenly interested in legislation and governmental policies and worked tirelessly and effectively in behalf of the principles of free competitive enterprise.

William H. Price, 61, veteran mid-west coal miner, died December 16.

Active in mining operations in southern Illinois for more than 40 years, Mr. Price was general superintendent of the Peabody Coal Company's River King Mine at Freeburg, Ill., and of the Seminole Coal Corporation's Seminole Mine at New Athens, Ill. He had been with Peabody for 35 years.

John C. Gall, 56, a well-known attorney in the coal and steel industries, died in mid-December.

Mr. Gall was considered an expert on labor law and had participated in many Congressional hearings leading to enactment of labor legislation. He represented various coal groups in the "portal-to-portal" and other coal cases, and represented the steel industry in many court actions.

NEWS

and VIEWS



Eastern and Central States



Coal Research Center

The bituminous coal industry, major coal users, and coal equipment suppliers have joined in an effort to establish a major coal research center in Pittsburgh to be operated by the bituminous coal industry.

This announcement followed a decision by the board of directors of Bituminous Coal Research, Inc., to consolidate the industries' research facilities in Pittsburgh. The consolidation will combine the present coal industry operated laboratory in Columbus, Ohio, the laboratory and administrative headquarters in Pittsburgh, Pa., and the organization's fiscal offices in Washington, D. C.

Work at the new research center will include basic research to fill in large gaps in the knowledge of the origin, physical structure and properties, and chemical behavior of coal. Activities will emphasize the development of improved coal utilization methods and equipment.

The broad objective will encompass preparation, transportation, handling, and storage of coal; its use as electric utility fuel, a more efficient utilization in the production of industrial steam and for space heating. Investigations will also be carried out relating to coal production and the use of coal by the iron and steel and nonferrous metal producing industries. In addition, research will be conducted in the fields of gasification, chemical and other process uses of coal.

Expected to be completed during 1959, construction will be financed primarily by capital funds from the coal industry. These will be supplemented by financial support from Pittsburgh industrial companies. A subscription program is under way at the present time with L. C. Campbell, retired vice-president of Eastern Gas & Fuel Associates, Inc., as chairman of the fund raising committee. R. H. Hughes, president of Clinchfield Coal Co., is vice-chairman.

Arkansas Manganese Deposits to Be Explored

American Potash & Chemical Corp. has concluded arrangements for exploratory investigations of manganese ore deposits near Batesville, Ark. Mineral rights to the land are held by four Arkansas companies: U. S. Manganese Corp., Miller-Lipp Corp., Arkansas Mining & Exploration Co. and Miller McGree Manganese Corp. If exploration results are favorable, a new company will be formed with

55 percent of the stock owned by American Potash. Operations have been conducted on a limited scale at the Batesville properties by the four Arkansas companies for several years.

R & P Sells Coke Subsidiary

Shenango Furnace Co., Pittsburgh, has purchased the Lucerne Coke Co. at Indiana, Pa., from the Rochester and Pittsburgh Coal Co.

Lucerne Coke Co. operates 264 beehive coke ovens. These ovens, built in 1952, are the newest of their kind in the United States. Part of Lucerne Coke's future production will be used in Shenango Furnace Company's own blast furnace at Sharpsville, Pa., and the remainder sold to coke consumers in the Pittsburgh district.

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WHEELS OF GOVERNMENT

(Continued from page 141)

the Organization for Trade Cooperation (OTC), extended minimum wage coverage and improved unemployment compensation coverage, higher postal rates, and statehood for Alaska and Hawaii.

Of particular interest to the mining industry was the proposed cut in funds for the stockpile program. The President said stockpile objectives for all but a few scarce materials will be approximately completed under contracts now in force, and estimated that only \$422 million will be needed for both stockpiling and defense minerals activities.

No funds were requested for the domestic tungsten purchase program which Congress authorized in 1956 but for which it refused to appropriate monies last year.

COAL RESEARCH AGENCY URGED

Coal-state Congressmen have begun a drive for the establishment of a Coal Research and Development Commission, long urged by coal industry organizations. A number of Representatives have taken the House floor to ask expeditious and favorable consideration of bills on the subject.

A House Interior and Insular Affairs Committee report last year recommended that such a Commission be established, and several bills to implement the recommendation have been introduced. Although the bills are not identical, most of them provide for a Commission of three members appointed by the President and confirmed by the Senate. The objective of the Commission would be to develop new and more effective uses for coal, to improve and expand existing uses, and reduce the costs of production and distribution—emphasizing those developments of particular value to the small coal operator.

To achieve these objectives, the Commission would be required to promote and coordinate research information on production, preparation, distribution and uses of coal, conduct research projects, and act as sponsor or co-sponsor of projects conducted by industrial associations, educational institutions, nonprofit groups and private consulting firms along with other branches of the Federal Government.

An advisory committee would be created, made up of members selected on a geographical basis and representing the various phases of the industry.

Both the Coal Division and the Manufacturers Division of the American Mining Congress testified at the House Interior Committee hearings last year urging establishment of a broad scale Government-industry coal research program.

Acquires Sand and Gravel Property

Howard I. Young, president, American Zinc, Lead & Smelting Co., has announced the acquisition of the physical properties owned and controlled by the Knoxville Sangravl Material Co., Knoxville, Tenn., by the Knoxville Sand & Gravel Co., a wholly-owned subsidiary of American Zinc.

The purchase includes two heavy-duty dredges for excavating sand and gravel in the Tennessee River, two diesel equipped tow boats and other

auxiliary equipment for the recovery of river sand and gravel. A crushing, screening, and classifying plant is located at Knoxville.

Acquisition of this operation, coupled with American Zinc's Mascot, Tenn., by-product operations and the Midway and White Pine quarries, will give the company a completely diversified operation for the production and delivery of road-building aggregates for concrete, masonry, and asphaltic construction. The acquisition also includes a ready-mix batching plant, and 11 ready-mix concrete trucks.



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Anaconda Buys Iron Property

The Anaconda Co. announced recently that it had exercised options to buy iron ore claims and properties from the Lake Superior Iron Ore Co. of Montreal and the Jean Gourd Syndicate. The properties are located in Ontario on the headwaters of the Albany River.

Present plans call for the ore to be mined by open-pit methods and concentrated and then shipped by rail 190 miles to docks at Nipigon, Ontario, on Lake Superior where it would begin its trip to the steel furnaces of Canada and the United States. Unofficial reports indicate the company plans a production of up to 2,000,000 tons of concentrate per year.

The property is about 25 miles long and varies in width from one to four miles. It is reported the low-grade magnetite ore averages around 25 to 30 percent iron which could be processed into a 64 to 68 percent iron concentrate.

A new company is being formed named Anaconda Iron Ore, Ltd., which will be 90 percent owned by Anaconda, eight percent by Lake Superior Iron Co., and two percent by the Jean Gourd Syndicate.

New Bauxite Process Announced

The U. S. Bureau of Mines recently announced a new process for the beneficiation of bauxite to make it suitable for alum production on a commercial scale. Tests for the new process were conducted at the Quapaw deposit, Saline County, Ark., and the tests indicate the process can be applied to similar low-grade elsewhere.

The ore tested by the Bureau contained two to three percent iron-oxide which is more than can be tolerated in alum production. Treatment by the new process reduced the iron-oxide content to less than two percent.

Alum is used in water purification,

tanning, meat packing and power manufacture.

The Department has released a technical report describing the method entitled "Laboratory Investigation of Bauxite Ore from the Quapaw Deposits, Saline County, Ark." The report may be obtained by writing the Publications-Distribution Section, Bureau of Mines, 4800 Forbes Street, Pittsburgh 13, Pa., and asking for Report of Investigations 5366 by title.

Two Alabama Coal Mines Planned

Southern Electric Generating Co. is building a \$150 million electric generating plant at Wilsonville, Ala., that will use about 3,000,000 tons of coal a year. The plant, which will be one of the world's largest power producers, is jointly owned by Alabama Power Co. and Georgia Power Co.

To supply coal needs, two mines will be opened in Alabama. The first will be in the Warrior field, south of Parrish, and is scheduled for full operation late in 1960. Its annual production will be about 1½ million tons.

A second mine, to be located in the Cahaba field, is now in the planning stage. An exploratory slope is to be driven some 1500 to 2000 ft from an outcrop into the Montevall seam, near Maylane, to establish mining conditions. The work will start early in 1958.

Haile Mines Diversifies Further

Completing another step in its program of diversifications, Haile Mines, Inc. has announced the acquisition of National Paint & Manganese Co., Lynchburg, Va. National Paint & Manganese will operate as a division of Haile.

The principal business of the newly acquired company is the production of manganese ores. These ores, in turn, are sold almost entirely to the brick industry as a coloring agent.

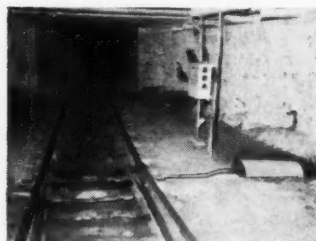
Maine Survey

The Maine Geological Survey, a division of the Department of Economic Development, has undertaken an aeromagnetic and geologic reconnaissance survey of an area comprising one million acres in south central Maine. The project has been contracted to the James W. Sewall Co., Consulting Engineers, Old Town, Maine, with the aeromagnetic survey sub-contracted to Aerogeophysics, Inc., Los Angeles, using a Varian nuclear precession magnetometer. The aeromagnetic survey includes three widely spaced groups of long flight lines with a fill-in in anomalous areas. Geologic mapping includes compilation of reliable data from various published and unpublished sources in addition to reconnaissance mapping on the ground and from the air. John R. Rand, State Geologist, anticipates that the survey will be completed for a release date late in February 1958.

Exploring New York Iron Deposit

W. S. Moore Co., Duluth, Minn., currently operating on the Mesabi Range in Minnesota, has two drills exploring several magnetite ore bodies in the vicinity of Newton Falls, N. Y. The nature of the ore is similar to that found at the Jones & Laughlin's Benson mines in the general area. If sufficient open-pit reserves can be proven, a concentrating plant to produce 300,000 to 400,000 tons of high-grade pellets annually will be built.

Robert Simon, mining engineer for the W. S. Moore Co., is in charge of the drilling. The major deposits are owned by the Newton Falls Paper Mills, Inc., however, one of the properties, the Parish anomaly, is owned by International Talc Co. If and when developed, the mines will be operated on a year-round basis. From 4,000,000 to 6,000,000 tons of concentrates produced by open-pit operations will be required to justify construction of a magnetic separation plant.



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TVA Coal Purchases

The Tennessee Valley Authority ordinarily maintains a 60 to 90-day coal stockpile at each of its major steam plants and a majority of this coal is hauled by railroads, according to a recent release from the TVA.

The announcement said that of the nearly 20.4 million tons of coal delivered to TVA steam plants during fiscal 1957, 46.1 percent was transported entirely by rail, 35.5 percent by a combination of rail and barge, 10.7 percent by barge alone and 7.7 percent by truck.

Coal purchases are made in Kentucky, Tennessee, Illinois, Virginia, Indiana and Alabama, according to the release, and each of the steam plants is served by at least one railroad. In addition all the major plants are located on navigable inland waterways except for John Sevier near Rogersville, Tenn.

The announcement explained that TVA purchases coal on competitive bids with at least 75 percent of the purchases being made on "term" contracts which are of six months or longer duration. Additional coal is also purchased on "spot" contracts which usually cover deliveries to be made within a month. TVA bids and pays for the coal on a basis of its cost per million BTU delivered to the plants rather than on a ton basis.

Coal deliveries during fiscal 1957 were by rail, 9,383,738 tons; by rail-barge, 7,239,377 tons; by barge, 2,185,152 tons and by truck, 1,566,610 tons.

Crucible Buys Rem-Cru

Crucible Steel Co. of America announced recently that, subject to Securities and Exchange Commission approval, it had acquired 100 percent ownership of Rem-Cru Titanium Inc.

Crucible president Joel Hunter said, "It has become increasingly evident in recent months that the titanium business can best be conducted as a part of the specialty steel business. Plant facilities for production of titanium are virtually identical with those required for stainless and other specialty steels and alloys in which we are interested, and there are many things in common in marketing and research activities. In addition to acquiring valuable properties and the services of personnel employed at Rem-Cru, we will be in a better position to continue the development of titanium, which continues to show the great promise for the long pull."

Rem-Cru Titanium, Inc., was organized in 1950 as a joint venture of Remington Arms Co. and Crucible. In plant facilities adjacent to Crucible's works at Midland, Pa., it has produced titanium ingots, slabs and billets from purchased titanium sponge for conversion into sheet,

bars, wire and other mill products, chiefly in the Crucible plants. Rem-Cru's plant consists of 237,000 sq ft of factory buildings and engineering, office and research buildings on 11 acres of land in Midland as well as 262 acres near Midland. Equipment includes vacuum arc melting furnaces, heating, forging, vacuum annealing and grinding facilities as well as extensive technical and laboratory equipment. As a result of its emphasis on the development of titanium alloys, Rem-Cru possesses valuable patents which are licensed for use by other producers.

Ford Sells Coal Lands

The Ford Motor Co. recently announced the sale of some 70,000 acres of coal and timber land, located in Leslie, Clay, Bell and Holland Counties in eastern Kentucky, to Potomac Industries of Washington, D.C. The sale represents part of 115,000 acres of property purchased by Ford in 1925. At that time it was the Ford Motor Company's interest in hard woods for use in autos that motivated the purchase of the property, part of which is now being sold.

Fordson Coal Co., a subsidiary of Ford Motor Co., retained gas and oil rights on all acreage sold in the re-

cent transaction, along with coal and mineral rights on 10,000 acres. Potomac Industries gets mineral rights, including coal, on about 60,000 acres. Ford will still control outright 30,000 acres in Pike County.

Y. & O. Buys Tracts in Ohio

Announcement was made recently of the purchase of 119 tracts of coal land by the Y. & O. Coal Co. of Martins Ferry, Ohio. The purchase was made from the No. 8 Coal Co. It is estimated that the tracts involve 5700 acres, with most of them in the vicinity of Martins Ferry.

Ravenswood Plant in Operation

The first Ohio Valley production of aluminum based on coal-generated power flowed recently from the Ravenswood, Ohio, plant of the Kaiser Aluminum & Chemical Corp. The \$216,000,000 Ravenswood Works is located about midway between Pittsburgh and Cincinnati and is one of the first aluminum operations in the world designed as an integrated operation.

When fully completed, probably in 1960, the plant will have an annual capacity of 145,000 tons of primary aluminum in the form of pig or ingot, plus a capacity of 170,000 tons of rolled products.

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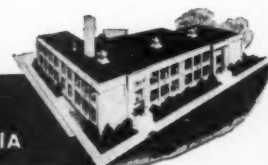
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New Iron Ore Reduction Process

Tandem Mines, Ltd. has announced a new iron-ore smelting process which the company states may promote large deposits of iron now considered valueless because of their titanium content into the commercial category. The process is the invention of Dr. Roy A. Halverson of Detroit.

The Halverson process involves the introduction of controlled quantities of an alkali flux in the form of common salt into the oxidizing zone of the reducing furnace by compressed air. In tests by Tandem Mines, ore from the Madoc area of Ontario was treated in a large cupola furnace under conditions duplicating as closely as possible those in commercial operation. The ore contained approximately 50 percent iron and between six and nine percent titanium, plus other common impurities which present no special problem. Six successive tests on this ore yielded iron with only 1/10 of one percent of titanium. Analysis showed that all other titanium in the ore had been freely floated off in the slag, which was extremely fluid and did not contaminate the furnace.

The company reports that the process appears to be equally appli-

cable to electric furnace or blast furnace operation. The modification necessary for the introduction of the special flux is simple and inexpensive and the quantity of salt used does not appreciably affect smelting costs.

Tandem Mines is now in the process of acquiring properties with ore suitable for smelting by the Halverson process. Generally speaking, all iron ores containing more than one percent and less than 30 percent titanium have hitherto been considered valueless due to the presence of titanium.

Pickands Mather to Handle Enos Coal Sales

An agreement was signed December 12 by the Enos Coal Mining Co., Cleveland and Indianapolis, and Pickands Mather & Co., Cleveland, naming Pickands Mather as exclusive sales agent for Enos Coal Mining Co., a large Indiana producer of industrial and utility grade coal. The transaction provided for a substantial dollar investment in Enos by Pickands Mather and for the transfer of Enos sales organization to Pickands Mather, where it becomes the Enos Coal Sales Division. O. E. Scales, former executive vice-president of Enos, joins Pickands Mather to take charge of the newly established sales division.

Peabody Closes Illinois Mine

Peabody Coal Co. has announced the closing of Peabody Mine No. 17 at Pana, Ill., and at the same time announced the substantial completion of the company's \$40,000,000 expansion plan begun three years ago. Mine No. 17 was sunk in 1947 at a cost of nearly \$10,000,000.

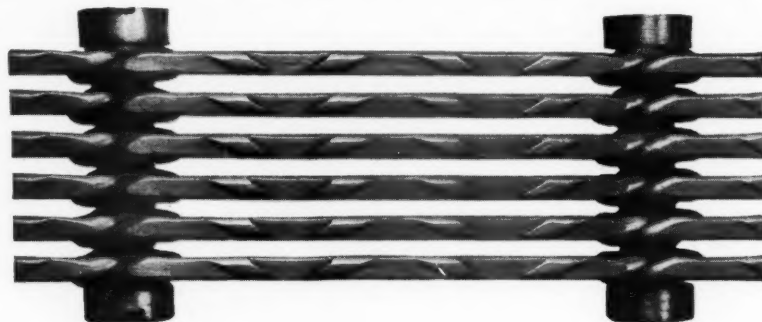
Production lost by the closing of No. 17 (2,000,000 tons annually) is more than offset by tonnage from three new mines recently opened by the Peabody and two more to be opened in the coming few months. Total potential capacity of these five mines is 8,000,000 tons a year.

In 1957 Peabody produced slightly more than 22,750,000 tons as compared to 21,300,000 tons in 1956 and 19,000,000 tons in 1955. These figures are exclusive of coal sold by Peabody from mines of other producers. The company anticipates an increase of two to three million tons in 1958 as against 1957 production.

Scientists Study Russian

At least 30 scientists from the Department of Mines & Technical Surveys, Ottawa, will attend a 25-week language course in scientific Russian this winter at Carleton University.

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West Virginia Preparation Plant Progressing

Work is rapidly nearing completion on a new coal preparation plant being constructed by the Hanna Coal Co. at the firm's new Ireland coal mine south of Moundsville, W. Va., according to an announcement by company officials.

It is expected the new plant will go into operation by the end of this year. The 100-ft high plant will clean, crush and separate the coal which will move on conveyor belts to the new Kammer power plant, to river barge docks or to storage pits for later use. The conveyor belts are yet to be installed.

Ready Nicaro for Sale or Lease

A public invitation to all interested firms to call upon the General Services Administration for facts and figures about the Nicaro nickel plant in Cuba, prior to its formal offering for sale or lease, was announced by the agency recently.

The information presently available includes cost and operating data of detailed character. Moreover, GSA is prepared to open the Government-owned plant to firms which indicate a desire to send inspection teams to the site in Oriente Province in eastern Cuba.

In view of the size, scope, and character of the Nicaro operation, GSA plans to give potential and prospective bidders ample time to complete their investigations. No date will be fixed for bidding until all firms demonstrating a bona fide interest have had the opportunity to collect and review the available data. This will also give interested firms time to arrange financing.

Prior to formally offering the plant for sale, the United States Government will conclude discussions with the Republic of Cuba relative to carrying out plans to dispose of the plant.



With its ore bodies, the plant represents a net Government investment of \$85,000,000. It is capable of producing an annual outturn of 50,000,000 lb of nickel. The plant is today fully operative on a profitable basis.


Until mid-1956, a substantial part of the nickel production was placed in the national stockpile. Since May 1956 it has all been diverted to industry. Title to the plant, including the related ore bodies, is vested in Cuban Nickel Co., a Cuban corporation, with all the stock owned by the United States Government. Disposal terms, whether by lease or sale, will include appropriate provisions designed to assure the availability to the United States of Nicaro's productive capacity for defense requirements.

FEBRUARY, 1958


BEE-ZEE SCREENS

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When volume of production or quality of product is bottlenecked by a screening problem, find out how Bee-Zee Screens can make a difference! You can retain high Btu-content, dewater, size and heat-dry coal fast and efficiently with these welded stainless steel Bee-Zee Screens. Specially shaped rods are precision-spaced by electronic control - in screen size, type and dimensions tailored to your specific equipment and requirements.

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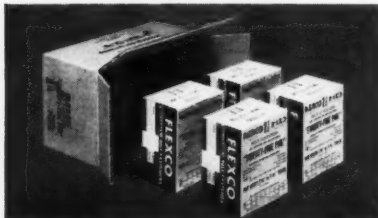
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Canada's Mining Industry Sets Record

In spite of lower prices for many metals, and lessened demand for many of its products, Canada's mining industry set another new record for value of production in 1957. The Dominion Bureau of Statistics' annual production estimate places output at \$1.57 billion compared with \$1.56 billion in 1956. It shows nickel as the leading metal now, with copper in second place. The biggest relative gain of the year was made by uranium, up \$85,000,000 to reach almost \$131 million.

Glen Alden Adds Directors

The board of directors of the Glen Alden Corp. was expanded recently from six to nine members with three officials of List Industries Corp. elected to membership.

The new board members are Albert A. List, president and chairman of List; Dudley G. Layman, List's financial vice-president; and Major Gen. Royal B. Lord, chairman of the executive committee. List recently acquired about 675,000 shares of Glen Alden's outstanding stock. This figures to about 38 percent.

List industries was formerly RKO Theatres Corp. and has interests in textiles, electronics, real estate and other businesses. Glen Alden is primarily a producer of hard coal, but in recent years has diversified and has subsidiaries which produce fire trucks and air conditioners.

Cleveland-Cliffs Curtails

Michigan operations of the Cleveland-Cliffs Iron Co. have been cut, with approximately 175 employees laid off due to the curtailed operations, according to an announcement made by the company.

Officials said the curtailment was brought about because of reduced demand for iron ore by steel mills and increased imports of high-grade foreign ores. The operating schedule for the winter months will depend on the outlook for the steel industry, according to company spokesmen. It was also pointed out that the present reduction in demand for Michigan underground iron ore is due not only to slackening of steel production but the low price of scrap which can be used in place of iron ore in the production of steel.

Options New Jersey Ilmenite Deposit

American Smelting & Refining Co. has secured options on a large acreage in the vicinity of Lakehurst, N. J., containing what is thought to be a large deposit of ilmenite. Sampling of the deposit and metallurgical research are being carried on by Asarco.

Mine Drainage Projects in Pennsylvania

Approval of three mine-drainage projects to prevent flooding of valuable anthracite reserves in Pennsylvania has been announced by the Department of the Interior. Total cost is estimated at \$474,000 and will be shared equally by Pennsylvania and the Federal Government.

Two of the projects are located in the northern anthracite field near Wilkes-Barre and involve paving parts of two stream channels through which water seeps into inactive mines and collects in large underground pools. Heavy rainfall could cause these pools to rise. Water would then inundate pumps and flow into adjoining active mines.

The third project in the southern field, near Tamaqua, calls for a system of earth ditches and steel flumes

Sahara Establishes Scholarship

The Sahara Coal Co. has established a four-year scholarship in mining engineering at the University of Illinois through the Illinois Mining Institute, according to a recent announcement from the University.

Preference in awarding the scholarship will be given, in order, to a son or relative of a Sahara Coal Co. employee, a resident of Saline County, Ill., a resident of Illinois, and a resident of any State in the Union. The scholarship will pay \$500 per year and the recipient will be selected by the University's scholarship committee.

Copper Lode Found in Michigan

Discovery of a new copper deposit in the upper peninsula of Michigan was announced by American Metal Company, Ltd. The discovery was made by a wholly-owned subsidiary of the parent company.

On the basis of the 132,000 of diamond drilling that has been done, American Metal estimates a deposit of about 50,600,000 short tons of copper-bearing shale (average copper content of 1.52 percent) and an additional 54,400,000 short tons of lower grade shale (average copper content 1.04 percent) is indicated.

A development shaft is down, the company said, and time will tell whether the deposit is economically workable.

Coal Company Sold

Buckeye Coal & Coke Co., Stephenson, W. Va., has been sold to the Page Coal & Coke Co., Bluefield. Going into production in 1888, Buckeye Coal & Coke was the fifth mine to be opened in the Pocahontas coal field. Page Coal & Coke, the company buying Buckeye, has been mining coal in the Pocahontas coal field since 1904. It is affiliated with Crozer Coal & Land Co.

Eastern Gas to Construct Plant

Eastern Gas & Fuel Associates Eccles No. 6 mine will be closed the first eight to ten months of this year while a new modern coal preparation plant is being constructed. Addition of the plant is required to enable Eccles No. 6 to produce a better quality of coal to meet competition in today's market, Eastern Gas said. The coal will be processed through a wet-type washer.

Three Cement Producers Merge

At separate meetings held December 2, the shareowners of Riverside Cement Co., Peerless Cement Corp. and Hercules Cement Corp. voted in favor of an Agreement and Joint Plan of Merger which provided for the merger of the three companies. The name of the new company is American Cement Corp.

Riverside Cement Co. is one of the two largest producers of cement in southern California. Its two plants have a combined annual capacity of 8,500,000 bbl. In 1956 the company acquired an additional large deposit of cement raw material in Arizona and an option on a large deposit in northern California. At present both of these deposits are outside the company's marketing area and studies are being made to determine whether and when these deposits should be exploited.

Peerless Cement Corp. operates three plants, two in Detroit and one at Port Huron, Mich., and serves parts of Michigan, Indiana and Ohio. Peerless is capable of producing 6,500,000 bbl of finished product, including slag cement and mortar cement, annually.

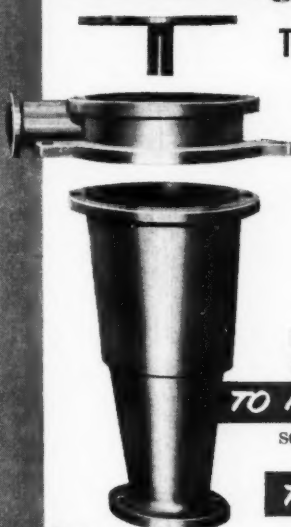
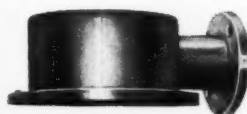
Hercules Cement Corp. serves Pennsylvania, New York, New Jersey, Maryland and the New England States from its plant at Stockertown, Pa. The company's annual capacity was increased last year to 3,560,000 bbl with the completion of a six-year rebuilding program.

Combined annual capacity of the new American Cement Corp. will be 18,500,000 bbl, ranking it among the five or six largest cement producers in the United States.

A basic policy of the new corporation is to operate through substantially independent units. Insofar as possible the three divisions of American Cement Corp. will continue to operate in the same manner as when separate corporations.

Officers of American Cement include: Garner A. Beckett, chairman of the board of directors; W. C. Russell, vice-chairman of the board, and chairman of the executive committee, and D. S. McBride, president. Division officers include: J. P. Giles, president, Hercules Cement Co.; W. C. Russell, president, Peerless Cement Co., and J. M. Kinard, president, Riverside Cement Co.

H & P wet cyclones



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VERTICAL MODEL 106-24

**World's Fastest Heavy-Duty
Vertical Auger Drill**

Bores faster, deeper, larger dia. holes than any other auger drill. New gear reduction unit slows auger rotation for operation in hard rock formations. Drills 8" and 9" dia. holes readily in shale and sandstone formations, drills larger dia. holes up to 24" dia. in softer formations.

Write for Bulletin M-100

FINGER-TIP CONTROL



Gives Desired Rotating
Speed Of Auger

HYDRAULIC FEED



Provides Any Speed Up To 6 Feet
Per Minute Horizontal
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COAL RECOVERY

*"Walks" from hole to hole to auger
high-quality Bonus Coal*

An Ohio miner removes 450 tons of coal in each 6 1/2-hour working day with this Model 14 36-42 x 12' McCarthy drill, operated by two men. He drills 42" dia. holes 144' deep. Auxiliary conveyor eliminates spillage at hole. It operates on either side of drill for working blind cut. Twelve different models of McCarthy Coal Recovery Drills mine low-cost "bonus coal."

Write for Bulletin M-101 and M-102



HORIZONTAL MODEL 104

**Lowest Drilling Costs per
foot, Self-Propelled or
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Bores up to 12" dia. holes to 150' depth faster, cheaper than any other horizontal drill. Requires less working space, saves many man-hours. . . operates easily in tight, hard-to-reach locations.

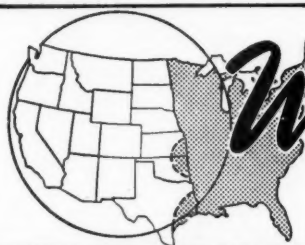
Write for Bulletin M-105

THE SALEM TOOL CO.

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Western States

Kaiser to Reopen Coal Mine

The present multi-million dollar modernization and expansion program of Kaiser Steel Corp. includes two major parts of prime interest to the coal industry and the area around Raton, N. M.: An exploration program to find areas of high-quality coking coal for future use, and the rehabilitation and modernization of underground and surface installations at the Koehler mine near Raton, for many years a leading coal producer in New Mexico.

Kaiser officials report that the firm's Fontana, Calif., plant is now in the initial phase of a \$194,000,000 expansion program, and that 60 percent of the added coal requirements will come from the Koehler mine. Recoverable coal reserves at Koehler are estimated at 10,000,000 tons.

Cost of the phase of modernization at Koehler has been set at \$2,500,000 with \$1,500,000 being used for new modern equipment.

Underground operations consist of widening seven miles of haulageways to allow the use of cars carrying 15 tons of coal. Tracks will be converted from 60 to 90-lb rail, and the gauge of the track widened from 40 to 48 in. New equipment to be used in the operation will include two continuous mining machines, a pickup loader and a mobile roof-bolting machine.

The old Koehler washer plant, which was a mile east of the mine portal, has been dismantled and moved to the present dump location. Modern office, shop and maintenance buildings also will be erected.

It is believed that the mine will be in production in February and will employ about 200 men. Daily output will be 2000 tons of clean coal. As new equipment is received, tonnage will be gradually increased to 3250 tpd of clean coal, according to authorities.

AEC, Fremont Sign Mill Contract

The Atomic Energy Commission and Fremont Minerals, Inc., Denver, have signed a contract for the sale of uranium concentrates to the Commission which will result in the construction and operation by Fremont of a new uranium processing mill at Riverton, Wyo. The mill will have a

capacity of about 500 tpd; the estimated cost is \$3,500,000. It is expected to be completed by the end of this year.

The mill will serve as a custom milling facility for ores offered for sale by independent operators in the general Wyoming area. In addition, Fremont will purchase and process the Government stockpile of ore at Riverton.

Beginning February 1, Fremont took over the operation of the Government-owned ore buying station at Riverton and purchase ores in the Wyoming area.

Fremont is a subsidiary of the Sussquehanna Corp. of Chicago, which is also the parent company of Mines Development, Inc., operators of a uranium processing mill at Edgemont, S. D.

Large Gold Nugget Found in Alaska

University of Alaska school of mines, faculty and students recently studied a 34-oz gold nugget, apparently the largest brought to light in the territory in 43 years. Patrick "Patty" Savage found the nugget during his operations last summer on Long Creek near Ruby, approximately 300 miles west of Fairbanks, Alaska. The gold in the nugget is worth approximately \$1200. Another large nugget, weighing 96 oz, was found in the same area in 1914.

Northwest Ships Thorium

The first shipment of thorium concentrates from the Northwest was made recently by Northwest Prospecting & Development Co. of Spokane, Wash. The 2000-lb shipment, consisting of 900 lb of concentrates assaying 31.44 percent thorium oxide and 1100 lb of middlings assaying 0.386 percent thorium oxide, was sent to a Tennessee firm which produces thorium and rare earth chemicals. The concentrates were obtained from 26 tons of thorite mined at the company's property on Hall Mountain near the Washington-British Columbia border.

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They are rugged, dependable battery locomotives which are up to 20% more efficient and give longer battery life than other comparable locomotives. Well-fitted for the job, Greensburg locomotives have double equalizers exerting equal pressure on all 4 wheels for greater tractive effort, better braking, riding and roadability. Available in single or double motor drive with drum, cam or magnetic contactor type controller.

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Utah Mining Group Elects Officials

Charles A. Steen, president of Utex Exploration Co. and a vice-president and director of Uranium Reduction Co., has been elected president of the Utah Mining Association. He succeeds Clark L. Wilson, vice-president of New Park Mining Co.

Elected first vice-president was Oscar A. Glaeser, vice-president and general manager of Western Operations, United States Smelting Refining & Mining Co. Second vice-president is Lockwood W. Ferris, president of Bonneville Ltd. A. G. Mackenzie was renamed vice-president and consultant.



C. A. Steen



O. A. Glaeser



L. W. Ferris

Miles P. Romney was re-elected secretary-manager. Walter Horne was named assistant secretary-manager.

New directors elected to the 66-member group were Arthur McQuiddy, Columbia Iron Mining Division, United States Steel Corp.; J. M. Ehrhorn, industrial relations director, U. S. Smelting Refining & Mining Co.; A. M. Mastrovich, vice-president, Climax Uranium Co.; Gordon Miner, Homestake Mining Co.; Ralph W. Neyman, president, Federal Uranium Corp., and Radorock Resources, Inc.; J. F. Frost, mining engineer, American Smelting & Refining Co., and W. J. McKenna, general superintendent of Tooele smelter, International Smelting & Refining Co.

Mine Rescue Station for Grants Area

Ray Shultz, general superintendent of Rio de Oro Uranium Mines, Inc., has been named chairman of a committee to study plans and services of a proposed central mine rescue station for the Grants, N. M., uranium mining area. He was elected at a recent meeting of the various mining interests of the area called by John A. Garcia, state mine inspector. Shultz will appoint members of his committee.

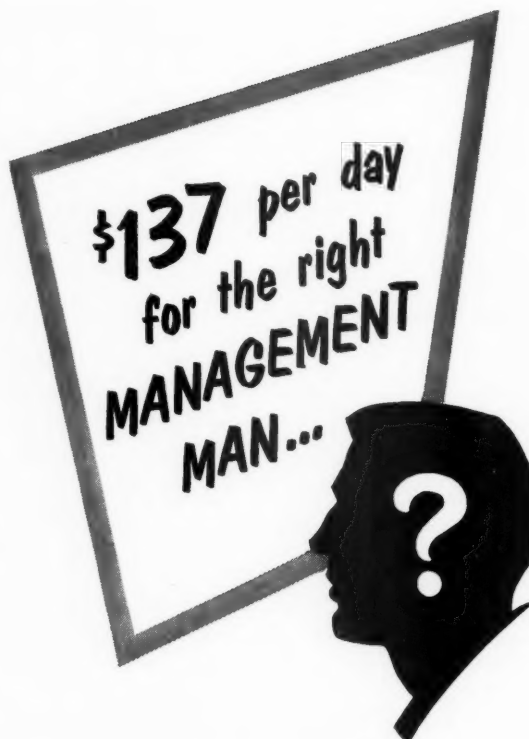
Among proposals to be considered by the committee will be the pooling of ambulance facilities, staffing of ambulances with trained personnel, construction of a first-aid room as an adjunct of one of the uranium mills now being built to provide central location, and possible inclusion of a fire station in connection with the mine rescue station. Problems of operation and financing also will be studied by the group.

Wyoming Plant to Supply Bentonite

A plant to supply bentonite for Minnesota's taconite industry is being built by Archer-Daniels-Midland Co. at Colony, Wyo.

The Minneapolis Company, a processor of agricultural commodities, has 25,000 acres of open-pit bentonite mining property in Wyoming. The clay is used as a bonding agent in the pelleting of iron ore powder extracted from taconite.

Warner B. Bishop, ADM vice-president and manager of the concern's Federal Foundry Supply Division, which operates the bentonite properties, said the Colony plant will be a push-button installation.



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PRESSURE TREATED TIES
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\$137 per day is a big saving. . . . but possible. You can save your company AT LEAST \$50,000 per year with OSMOSE PRESSURE TREATED TIES and TIMBERS.

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Leading mining companies substantiate our own enthusiasm. Pocahontas Fuel Company, Inc. says: "Our Company has been using Osmose Timber Treatment at various mines since 1942. We feel that sufficient time has now elapsed to prove the worth of your Treatment, and are pleased to advise that it has been very satisfactory to us."

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1000-TPD Uranium Mill Proposed

Vitro Minerals Corp. and the Atlas Corp. have submitted to the Atomic Energy Commission a joint proposal to build a 1000-tpd uranium mill in the Gas Hills Mining area of Wyoming. The proposal climaxes efforts started by Vitro early in 1956 to develop adequate milling facilities and provide a more stable ore market for Gas Hills uranium producers. It is one of several mill proposals now under consideration by the AEC.

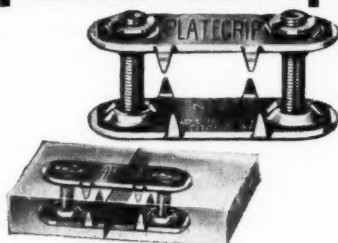
Vitro, owned 50 percent by Vitro Corp. of America and 50 percent by Rochester & Pittsburgh Coal Co., was formed in 1955. The proposal stated that since then a \$2,250,000 exploration and development program, carried out on less than 25 percent of Vitro's holdings in the Gas Hills, has indicated more than 1,500,000 tons of uranium ore reserves.

Tropico Hill Mine to Become Museum

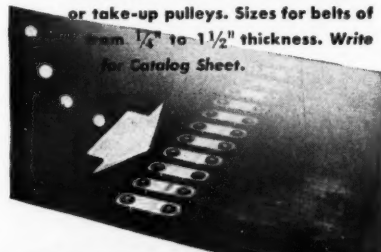
The historic Tropico Mine in the Rosamond, Calif., area, for years one of the Golden State's leading gold producers, will become a tourist museum. Visitors will have the opportunity of going through more than six miles of tunnels and shafts. The museum will exhibit mining equipment, materials, minerals and vehicles of all periods in California mining history.

PLATEGRIP

PLATE FASTENERS FOR CONVEYOR BELTS



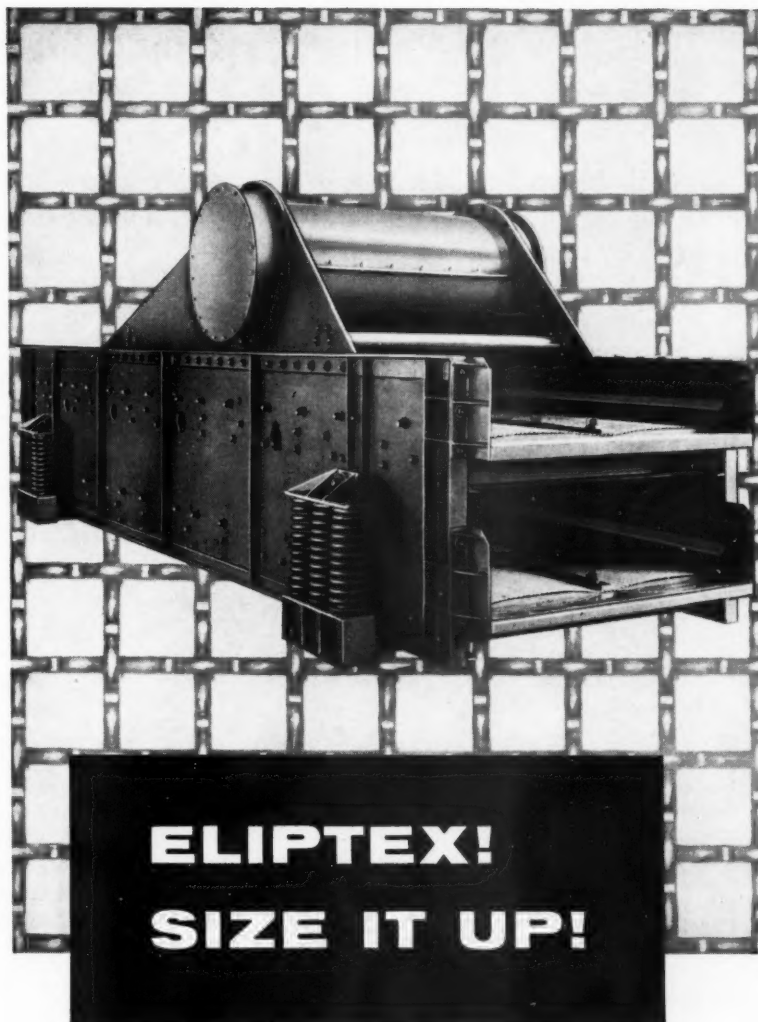
- Make strong dust-tight, water-tight joints in belts of any width. Special design spreads tension uniformly across belt, allow natural troughing of belt and assures smooth operation over flat, crowned or take-up pulleys. Sizes for belts of from 1/4" to 1 1/2" thickness. Write for Catalog Sheet.



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FEBRUARY, 1958

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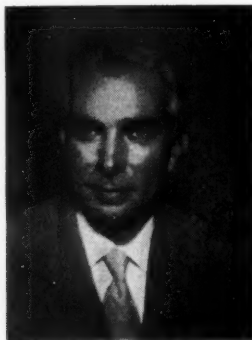
CONVEYOR BELTING AND IDLERS... POWER TRANSMISSION DRIVES
INDUSTRIAL HOSE... VIBRATING CONVEYORS, SCREENS & SHAKEOUTS

1958 Mining Show

Enlarged Facilities in San Francisco provide site for largest Metal Mining-Industrial Minerals Show ever held



John D. Bradley



Frank Coolbaugh



Jack H. How

JOHN D. BRADLEY, president of the Bunker Hill Co. and chairman of the Western Division of the American Mining Congress, has already made great strides in organizing the committees for the 1958 AMC Mining Show to be held in San Francisco next September 22 to 25. Acceptance of the Program Committee chairmanship by Frank Coolbaugh, former vice president of Western Operations, Climax Molybdenum Co., and now vice president of the newly-formed American Metal-Climax, Inc., was announced in December.

Jack H. How, president of Western Machinery Co. and chairman of the Manufacturer's Division of the Mining Congress, will play an important part in the exposition of mining equipment in conjunction with the meeting. The exhibits will fill the new Civic Center Exhibit Hall, the Civic Auditorium, and the street in front of the Auditorium.

Assisting Mr. Bradley as vice chairman of the General Arrangements Committee will be E. A. Hassan, Jr., manager, Exploration Department, Kaiser Aluminum and Chemical Corp. Chairman of the welcoming committee is W. Wallace Mein, president of Calaveras Cement Co. The publicity committee is headed by John L. Merrill, president of the Merrill Co., as chairman, and L. M. Holland, secretary of the mining committee of the San Francisco Chamber of Commerce, as vice chairman. J. A. Mecia, manager of the mining division of Utah Construction Co., is chairman of the trips committee.

The ladies hospitality committee is headed by Mrs. Jack H. How and Mrs. Paul C. Henshaw who have taken active charge as co-chairmen. Honorary chairmen are Mrs. W. Sprott Boyd, Mrs. Frank R. Girard, Mrs. D. C. Jackling, Mrs. F. F. Kett, Mrs. Jules LaBarthe, Mrs. W. W. Mein, Mrs.

H. R. Plate, and Mrs. George Starr. An outstanding program has been arranged for the visiting mining ladies in the fascinating city of San Francisco.

To Mr. Coolbaugh's Program Committee is entrusted the job of developing the various sessions—on both policy and technical matters—for the meeting. In view of far-reaching developments on the economic, legislative and technological fronts the 1958 convention promises to be an event of major importance. Leading authorities in every field will be on hand to discuss thoroughly the problems of the mining industry.

The exhibits of mining machinery, equipment and supplies will be of utmost value to every mining man. At no other single location can one see so much of the latest machinery that makes possible the progress of our metal mining and industrial minerals industries. More exhibit space is already under contract than the total space used at the largest previous mining show, held in Los Angeles two years ago.

A large attendance is assured at the convention and exposition, and San Francisco has promised to take care of all comers. There are many fine hotels in the city and comfortable accommodations will be available for all. Housing arrangements for the meeting are being handled through the AMC Housing Bureau, Room 300, 61 Grove Street, San Francisco 2, Calif. Hotel reservation forms will be sent to the industry this month. Mining men are urged to apply for reservations as early as possible and preferably by May 1. Processing of these requests will begin in May and the first assignments of accommodations will be made in June.

Nevada Mine Streamlines Haulage

Construction on a million dollar Rockover skip haulage system for the Tripp open cut copper mine of the Consolidated Coppermines Corp. is nearing completion. The project is expected to be in operation by April.

Streamlining of the ore haulage system of the pit at Kimberly, Nev., was announced last July as a major cost-cutting project necessitated by rising costs of production and depressed market price for copper.

Idaho Land Withdrawal Opposed

Harry W. Marsh, secretary of the Idaho Mining Association, has filed with the U.S. Bureau of Land Management a formal protest against proposed withdrawal by the U. S. Forest Service of more than 10,000 acres of land in Clearwater County, Idaho, thus closing these lands to mineral entry.

The proposed withdrawal would provide a "protective zone" along a timber access road, according to BLM.

Marsh said that the proposed withdrawals, for economic and national security considerations, should be made of the surface only and entry be permitted on the subsurface mineral rights under the mining laws in roadside strips, recreation areas and administrative sites.

The association recommended that "The responsible branches of Government require more worthy justification for said withdrawal to avoid locking up unnecessarily the minerals in such lands from public use and benefit."

Two Mining Firms Consider Merger

Directors of Vulcan Silver-Lead Corp. and of Callahan Zinc-Lead Co. recently named committees to study advisability of merging Vulcan into Callahan, according to Joseph T. Hall, president of both companies. Callahan now owns 62 percent of Vulcan's outstanding stock, he said. Vulcan owns the Galena mine west of Wallace, Idaho, a silver producer which is being operated under lease by American Smelting & Refining Co.

Silver Mountain Headings Pushed

Two headings are being pushed on a three-shift basis and diamond drilling is also being done at the Silver Mountain deep exploration project east of Mullan, Idaho.

A north crosscut toward the Snowstorm area has been advanced more than 2700 ft from the bottom of the 2000-ft shaft. Westerly drifting in the hanging wall of the Paymaster zone has progressed nearly 1400 ft. About 3000 ft of drilling has been completed in the Hecla-Bunker Hill venture.

The tough ones come to CARD



In hard rock mining, haulage equipment takes a real beating. Three-ton boulders drop ten feet and more into mine cars with a force that dents good half-inch steel plate. CARD cars have whipped these tough conditions for many of the major ore producers of the western hemisphere.

Familiar names like these and many others dot the C. S. CARD customer lists over and over with their repeat orders. CARD cars built to order for these firms cost little more than standard stock models, yet they result in large savings because they are built to handle specific mining requirements.

CARD car engineering can do the same for you. Ask us for consultation on your outstanding haulage problem. No obligation.

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INTERNATIONAL MINERALS
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VERMONT COPPER
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CALERA MINING
HOMESTAKE
TELLURIDE MINES
IDARADO
CANANEA CONSOLIDATED
COPPER CO.
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CLEVELAND CLIFFS IRON
POTASH CO. OF AMERICA
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SMELTING CO. OF CANADA
AMERICAN SMELT. & REF.
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NEW JERSEY ZINC

C.S. Card Iron Works Co.

2501 WEST 16th AVE.,
DENVER, COLORADO



EXIDE-IRONCLAD BATTERIES

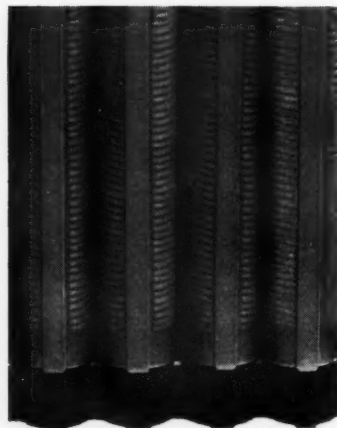
—best buy for the long haul

More ton-miles per dollar—that's the reason most cost-conscious mine operators prefer Exide-Ironclad Batteries for mine locomotives.

Experience has proved over the years that no other battery make matches Exide-Ironclad for average life in service and tonnage hauled. Rating for rating and dollar for dollar, Exide-Ironclad gives you more real value . . . more return on your investment.

Today's Exide-Ironclad features improved tubular construction, making it even better than the models that chalked up the industry's records. So you can expect even longer life potential and superior performance.

Total work output, not mere price, is the key to battery economy. When you buy batteries, specify Exide-Ironclad and get the most production capacity your dollar can buy. For details, write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 2, Pa.



High-capacity, long-life tubular construction. Gives positive plate one-third more surface area for greater power reserve. Power tubes hold active material securely for long battery life.

Exide®

Mine Tunnel Work Progresses

A projected 5720-ft tunnel to explore ground between the Page and Bunker Hill mines near Kellogg, Idaho, has advanced 180 ft in one month. By the middle of December the tunnel had been driven a total of 260 ft.

Work on the lead-zinc properties is being conducted under a \$660,206 contract with the Defense Mineral Exploration Administration.

Kennecott Furloughs 900 Men

Kennecott Copper Corp. has furloughed some 900 employees in Utah, Nevada and New Mexico in a 12-percent cutback in production. More than half of the layoffs are in the Utah Copper Division.

The estimated reduction in production is 3800 tons monthly.

In cutting output of its Utah Copper, Nevada Mines, and Chino Divisions, Kennecott placed those divisions on a six-day week. Under this schedule, the divisions operate 12 consecutive days and shut for two days. The Ray, Ariz., Mines Division already had been on a six-day week.

Of the 900 men furloughed, 525 were in Utah, 180 in Nevada, and 182 in New Mexico. The company has some 11,000 employees in the four Western States.

Lead-Silver Mill to Recover Gold

The modern mill erected to concentrate lead-silver ore from the old Snowshoe Mine near Libby, Mont., is expected to recover gold formerly lost, according to Merger Mines Corp. Early-day operators of the mine are believed to have lost as much as \$400 per day in gold values during milling.

The company said almost every assay shows gold, but because of a lack of uniformity in the samplings, gold values have not been included in estimated profit margins.

The estimate of ore immediately available for milling has been upped from 12,000 to 17,000 tons, and blocked out and probable ore is estimated at 283,000 tons.

At the mill, five miles from the mine and at a lower elevation to permit year-round operation, electrical equipment is being installed and tested.

Winter Stops Idaho-Custer Project

Idaho Custer Silver-lead Mines has discontinued for the winter its deep development project at the Livingston mine near Mackay, Idaho. Deepening of the mine shaft was completed to the 2750-ft level and a station and ore pockets cut in preparation for drift work next spring. Hecla Mining Co. of Wallace did the work under contract.

Pilot Plant to Test U-Ore Process

American Milling Corp. and Atomic Resources Corp., both of Albuquerque, N. M., have concluded an agreement providing for construction of a 25-ton pilot plant at Monticello, Utah, for the extraction of uranium from ore by the Yucca milling process. Purpose of the plant will be to prove the extensive value of the Yucca process.

Terms of the agreement provide that American Milling will purchase a 20 percent interest in Atomic Resources known ore body. This ore body is expected to provide the mill feed for the pilot plant.

American Milling has already been granted a license by the Atomic Energy Commission for unlimited purchase of uranium ore for milling purposes. Under this license the pilot mill will extract uranium oxide and vanadium pentoxide on an experimental basis.

Now under patent application, the Yucca process was turned over to American Milling by Yucca Mining & Petroleum Co., which own 70 percent of American Milling.

Coal Discovered in Antarctica

Outcrops of black coal, running for two miles, 6000 ft above sea level, have been discovered on the Upper Mawson Glacier of Antarctica, according to Douglas McKenzie, official correspondent with New Zealand's Antarctic expedition. He said that the exposed coal field, with seams from six to ten-ft thick, contains fossilized leaves and tree stems two ft in diameter. The field was sighted by air about 100 miles inland from Scott Base, New Zealand's Antarctic headquarters, and was subsequently investigated on the ground by geologists. Outcrops are imbedded in sandstone and the coal is sub-bituminous.

California Quicksilver Mine Sold

Two San Francisco mining engineers have sold controlling interest in a mercury mine lease in Trinity County, Calif. Bert C. Austin and L. A. Smith completed the sale to Rare Metals Corp. of America, a subsidiary of El Paso Natural Gas Co.

The lease involves the Altoona mercury mine, 35 miles from Dunsmuir in rugged mountain country. It has produced no mercury since 1902. A crew of men is now rehabilitating the mine.

Reorganized AEC in Operation

The Grand Junction, Colo., offices of the Atomic Energy Commission and field activities have been reorganized, according to Allen E. Jones, manager of the Grand Junction Operations Office for the AEC. Main change was in units responsible for the evaluation of source materials, uranium ore procurement, mining in-

centives and acquisition and production of uranium concentrates.

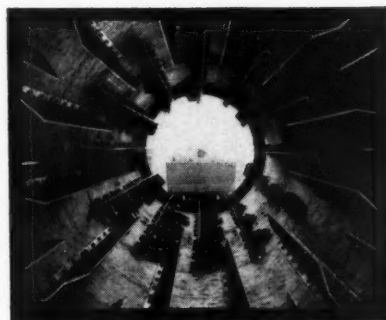
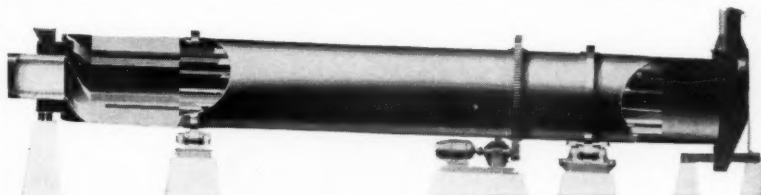
Major move is the opening of new offices in Casper, Wyo., and Grants, N. M. These branch offices will carry on the field activities involved in ore production information, appraisal and related geological activities.

Two new organizational units have been formed. The Production Evaluation Division and Source Materials Procurement Division will replace the Mining, Exploration and Concentrate Procurement Division.

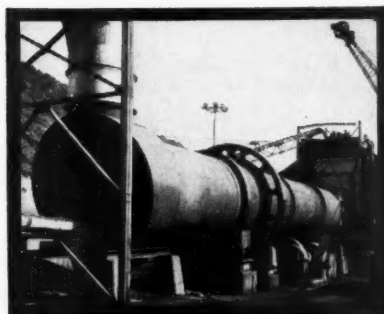
Source Materials Procurement Division will assume the ore purchasing

and sales functions now under the Mining Division. This, together with the concentrate procurement and production, will be combined under the ore unit heading. Production Evaluation Division will direct the leasing and mining incentive and resource evaluation programs now under the Exploration Division. This division also will assume the activities of the Exploration Division offices now in Denver and Salt Lake City.

Reorganization will reduce the total working force and will enable the AEC to serve the industry better, Jones reports.



Interior of shell of "XH" Ruggles-Coles Dryer showing lifting flights and "knock-out" chains.



10' diameter, 80' long "XH" Ruggles-Coles Dryer drying bauxite.

from
Alumina ores
to
Zircon concentrates

... in the drying of ores and concentrates. That is the story of Ruggles-Coles "XH" Dryers.

Small or large, each dryer is designed for the specific requirements of the user with the knowledge and experience gained from hundreds of installations.

Complete specifications upon request. Ruggles-Coles Dryers are described in Bulletin AH-438-52

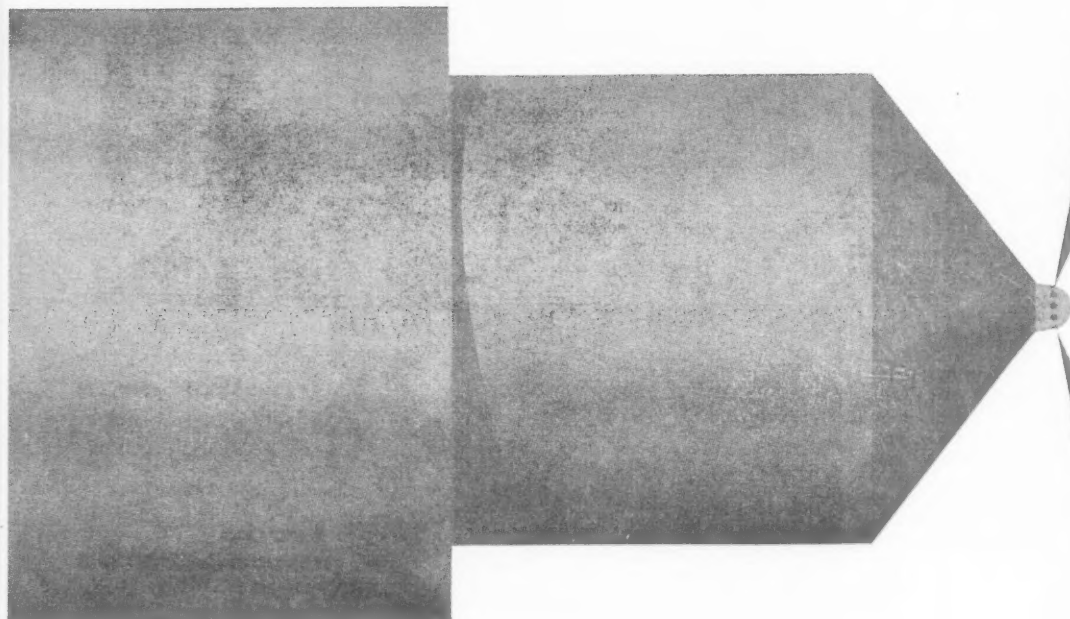
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How

STANDARD DIESEL FUELS

can help you cut coal hauler engine maintenance



You get three big benefits with STANDARD Diesel Fuels. They mean less engine maintenance, extended time between overhauls, more in-service operation per hauler—and *more profit on each ton of coal.*

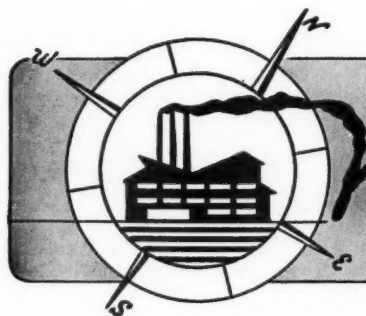
1. **STA-CLEAN***—a Standard Oil exclusive. This additive in STANDARD Diesel Fuels insures clean burning of the fuel, prevents fuel-injector sticking, minimizes rusting of fuel tank, fuel line and engine parts.
2. **Clean fuel.** Standard Oil exercises special care in handling your diesel fuel to make sure it is delivered to you *clean*. Contamination is eliminated. There's no foreign matter in the fuel to cause engine failure or maintenance problems.
3. **Balanced distillation** means you get good, economical engine performance. Cleaner engines mean better performance and longer periods in service between overhauls.

Check in with your Standard Oil industrial lubrication specialist for more facts about STANDARD Diesel Fuels. There's one of these specialists near you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY
(Indiana)



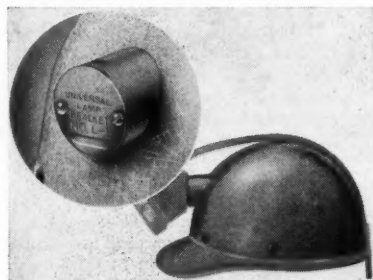
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Manufacturers Forum

Lamp Bracket for Safety Hats

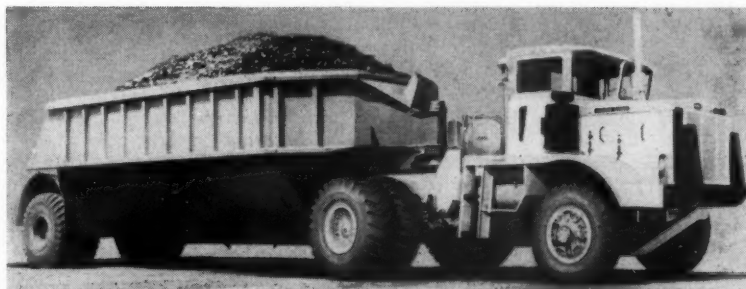
MADE OF POLYESTER RESIN, SuperGard safety hats and caps are now available with the No. L-1 Universal Lamp Bracket, which fits all types of Edison, Wheat and carbide



lamps. The L-1 accommodates both tongue clip and hook clip lamps, and is available separately for attachment to hats and caps already in service. The bracket is insulated against current passage.

Descriptive literature is available from Fibre-Metal Products Co., Chester, Pa.

50-Ton Tractor-and-Trailer Unit



A PLANETARY-AXLE tractor and a matched bottom-dump trailer with rated capacity of 50 tons have been developed by Autocar Division of White Motor Co., Exton, Pa., for off-highway use in coal hauling operations.

The AP-25T tractor, linked to the trailer by means of a universal hitch assembly, is powered by either a 335 or 375-hp turbo-diesel engine. The bottom-dump trailer is rated at a capacity of 61 cu yd struck or 69 cu yd heaped.

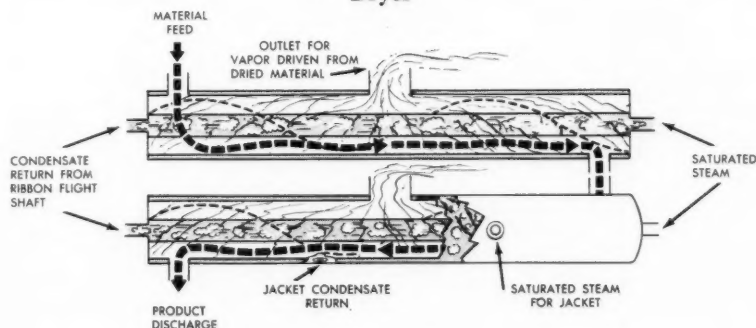
Such components as the rear springs and brackets, the brakes, wheel bearings and all outer-end parts of the tractor's drive axle are interchangeable with comparable parts from the trailer.

Total length of the units is 53 ft 4 in. Over-all width is 11 ft 8 1/2 in. Loading height is 11 ft from the ground.

Inquiries about new equipment appearing in Manufacturers Forum are welcomed.

For additional information on any piece of equipment in this section write directly to the manufacturer, or to Mining Congress Journal with name of item and date of issue in which it appeared.

Dryer



SECTIONAL VIEW OF RIBBON FLIGHT DRYER

THE RIBBON FLIGHT dryer is a stationary steam jacketed unit with an integral revolving shaft equipped with paddles and ribbon flight pitched to insure progressive movement of material through the dryer. Dryers are designed to permit stacking one above the other with right and left hand ribbon spirals to make multiple stacked installations with the drives and sprockets at one end. In normal

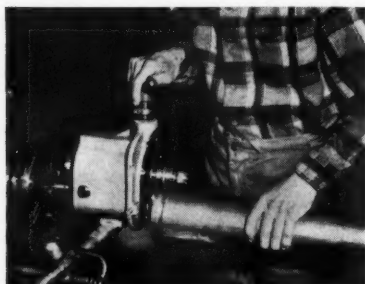
operation, the dryer uses 100 lb of steam pressure. The units are constructed to meet any pressure from 0 to 125 psi ASME code requirements, and are currently being used to dry free-flowing, non-sticky heat sensitive materials in relatively small capacities at low temperatures in various installations in the chemical field, according to Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Sling Chains

AVAILABLE IN SINGLE AND DOUBLE LEG STYLES and in six chain sizes from 1/4 in. through 3/4 in., the Kuplex Sling Chain assemblies were developed by the American Chain Division, American Chain & Cable Co., Inc., York Pa. Basic components of the Kuplex Sling Chain consist of an Accoloy shaped master link, a Kupler assembly consisting of load pin and fluted stainless steel drive pin, any length of Accoloy chain, and an Accoloy Kuplex sling hook or grab hook. All components are said to be inspected and proof tested at the factory to twice the normal working load limits.

Tools for Grooving Pipe

TWO PORTABLE tools that roll grooves into lightweight pipe and tubing—without removing any metal—have been added to the line of pipe groovers developed by the Victaulic Company of America, Elizabeth, N. J. Designated Vic-Easy Series 100 and Series 200, these tools for use on-the-



job or in-the-shop are adjustable from 1½ in. through 12 in. diameters. They groove pipe ends for jointing of water, oil, air or other lines with Vic-Easy snap-joint, standard or lightweight couplings.

The Series 200 is constructed for continuous duty on heavier wall thickness, the Series 100 for the occasional job on lighter wall thicknesses. Operation is either manual—stroking the ratchet handle—or power-operated from power vise, pipe machine, winch or hub drive of field trucks, etc.

Aluminum pipe with wall thicknesses up to 0.200 in. and steel pipe with wall thicknesses up to 0.188 in. may be grooved with the Vic-Easy tools.

Immersible Motor

FOR SUBMERGED OPERATION, this immersible motor is designed for close-coupling to agitators or pumps in sewage sumps, chemicals, water and abrasive industrial oils.

In pump applications this flange-mounted motor eliminates many connecting components since the motor shaft is directly attached to the impeller. Motor and pump can be raised and lowered into position together by means of the motor's lifting lugs. Features claimed include leak-tight construction, neoprene breathers, waterproof cable connection and corrosion resistant parts. It is available in ratings of ¾ to 40 hp, both single and polyphase.

For complete information, request Bulletin No. 2300 directly from Louis Allis Co., Dept. P, 427 E. Stewart St., Milwaukee 1, Wis.

Portable Semi-Automatic Welder

A WIRE FEED UNIT for semi-automatic open arc hard surfacing has been introduced by Alloys Rods Co. The semi-automatic welder will be sold under the trade name "Wear-O-Matic" Wire Feed Unit. The company also announced, for use with the

welder, a line of Wear-O-Matic open arc 7/16 in. diameter hard surfacing wires.

The Wear-O-Matic Wire Feed Unit, which will operate from nearly any d-c power source, is designed to use Wear-O-Matic wires packaged in convenient Payoffpaks. Thus, the wire supply is separate from the unit which weighs 70 lb, reportedly making portability from job to job a one man operation.

For complete details, request Bulletin AR-16 (99) from Alloy Rods Co., P.O. Box 1828, York, Pa.

Power Steering for Large Trucks

VANE TYPE hydraulic pumps specially adapted for steering systems of trucks with heavy front axle loading have been announced by Vickers Inc. of Detroit, Mich. Designated Vickers V200 Series with Integral Flow Control, the design incorporates an integral flow control and pressure relief valve which reportedly avoids the necessity of mounting an extra valve unit. Nominal rated capacities are 5, 8 and 11 gpm at 1200 rpm. Pump has maximum speed of 2200 rpm. All sizes are available with controlled flow rates 2, 4, 6 and 7 gpm at relief valve setting of 750 or 1000 psi.

Hydraulic Drum-Type Brake

FOR OFF-THE-ROAD EQUIPMENT, a full circle brake has been announced by B. F. Goodrich Aviation Products, Troy, Ohio.

Named the "Hi-Torque," it is said to be the first hydraulic drum-type brake with 360 degree expander tube actuation designed exclusively for large tractors, scrapers and earth-movers. The brake reportedly operates with nearly constant lining pressures at all points around the drum area.

The Hi-Torque is said to require no lubrication, eliminates mechanical shaft or cam alignment problems and can be disassembled with only standard hand tools.

The brake is bolted as a single unit to the axle or axle housing of the vehicle and uses either the existing air supply (with B. F. Goodrich master cylinder) or hydraulic power from the central system.

Loader

DUMPING CLEARANCES OF 13 FT 10 IN. under the hinge pin, and 11 ft 4 in. under the bucket cutting edge, are now obtainable on the two cu yd TL-20D Tractolader through the use of a special long boom arrangement, according to Tractomotive Corp., Deerfield, Ill.

With this long boom arrangement, the TL-20D has a minimum reach of 3 ft 3 in. at maximum height. At the nine-ft dumping clearance, the minimum reach is 4 ft 6 in.

Recommended for use in materials weighing up to 2700 lb per cu yd, the TL-20D with long booms has all the features of the standard model.

Huge Dump Truck



BUILT OF METALS supplied by Aluminum Company of America, this huge dump truck is said to contain the largest aluminum body ever built for a dump truck. The body has a capacity of 37½ cu yd. The truck is 30 ft 3 in. long, 12 ft 4 in. wide, 11 ft 11 in. high and weighs 27 tons.

A special feature of the body manufactured by the Heil Co. of Milwaukee is the heated dumper floor. Hot engine gases are channeled into the hol-

low body to facilitate dumping of moist and sticky bauxite. The truck will be used to haul bauxite for Alcoa at mining properties now being developed in the Dominican Republic.

The aluminum rig, built by Mack Trucks, Inc., Plainfield, N. J., is powered by a 335 hp turbocharged diesel engine and contains a four-speed torqueomatic transmission with a torque converter. It reportedly can carry a load of 67,000 lb.

Compression Cells

FOR ELECTRICALLY WEIGHING stationary or moving freight cars, trucks or carts, a series of strain gage load cells have been announced by Cox & Stevens Electronic Scales Division, Revere Corporation of America, Wallingford, Conn.

The compression cells, in small, hermetically sealed housings, are designed in nine capacities covering the range from 500 to 200,000 lb. Available now are 25,000, 50,000 and 100,000 lb cells; others reportedly are to be in production in near future. Cell construction is said to permit 225 percent overload without affecting calibration.

Feeder

A VIBRATING feeder has been developed by Hewitt-Robins, Inc., Stamford, Conn., to handle ore, coal, rock and other bulk materials in lump sizes up to four ft in diameter at a rate of 300 to 3000 tph. The machine is especially recommended for handling material at primary crushers and under hoppers and storage piles where heavy tonnages and lumps are transferred to a belt conveyor or other material handling equipment. The feeder is available in sizes ranging from 3 by 8 ft up to 7 by 16 ft.

Rotary Portable Air Compressor

POWERED BY EITHER A GASOLINE OR DIESEL engine, the Model RP 210 is available on two or four-wheel mountings, or on wood skids, according to Gardner-Denver Co., Quincy, Ill. With the addition of this model, the company's line of rotary portable air compressors now consists of five sizes: 125, 210, 365, 600 and 900 cfm.

A clutch between the engine and the compressor, said to be a design feature of all previous models, has been retained in the new units. An oil pump reportedly assures positive oil flow for compressor lubrication and cooling, independent of receiver pressure, under all operating conditions. Company officials also state that the water-oil cooling system maintains constant operating temperature for both compressor and engine, even during extremely hot or cold weather.

—Announcements—

Ray Mancha, vice-president with Joy Manufacturing Co. for the past 12 years, retired from active business December 31 to provide time for pursuit of personal interests and study, including work on advanced concepts of mine and industrial ventilation principles. His resignation fulfills a long-cherished plan to retire from active business at the age of 55.

F. J. Hirner, district manager of the Chicago Office of Harnischfeger Corp. since 1954, has been appointed sales manager-electric excavators for the Construction and Mining Division.

Robert G. Allen has been elected executive vice-president of Bucyrus-Erie Co. He joined Bucyrus-Erie last July as a vice-president.



In August he was appointed executive assistant to the president and placed in charge of all manufacturing operations.

J. D. Harmison was recently named sales manager, material handling, Buda Division, Allis-Chalmers Mfg. Co. He had been manager, Parts Sales, for the Tractor Group.

William J. McGraw has been appointed general sales manager of Thor Power Tool Co.

J. J. Sieber has been elected vice-president in charge of sales for the Broderick & Bascom Rope Co. He has been succeeded as sales manager of the company by **K. B. Britt**.

Walter E. Crowther has been appointed manager of the personnel relations department for Western Machinery Co.

The Portland Cement Association has announced the appointment of **E. P. Sellner** as manager of the Conservation Bureau and **J. L. Schneider** as secretary of the association.

W. C. Schumacher has been elected an executive vice-president and member of the board of directors of International Harvester Co. He formerly served as vice-president of the company and executive head of its motor truck division.

Upon the retirement of **John E. Kalinka**, president, Roberts & Schaefer Co., on January 1, **Robert Zaborowski** was named president and **Eugene V. Kipp** was made executive vice-president.

E. George Hartmann has been elected vice-president of sales, John A. Roebling's Sons Corp.

John W. Thornton has been appointed vice-president, marketing, for Joy Mfg. Co.

Carter Kissell was elected president of National Malleable & Steel Castings Co., Cleveland, January 27, and **Cleve H. Pomeroy** was named chairman of the board of directors.

Leonard Z. Budzen has been made manager of mining sales in the Metallurgical Products Department of General Electric Co.

Tom Learmont, engineer in charge, quarry and mining excavators, for Bucyrus-Erie Co., has received the



\$5000 first award from the James F. Lincoln Arc Welding Foundation, in a national competition sponsored by the Foundation for the design of machines improved through the use of arc welding. The winning design was for the welded steel base of Bucyrus-Erie's Model 1650-B, the "River Queen," a special long-range stripping shovel equipped with a 55-cu yd dipper. Learmont was the principal designer of the huge shovel. Welding saved 22 percent in weight, 15 percent of material costs with a net manufacturing savings of 24 percent.

CATALOGS & BULLETINS

WEATHER - PROTECTED MOTORS. Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. Allis - Chalmers weather-protected motors with enclosures built to NEMA Type II standards to meet requirements of outdoor service are described in Bulletin 05B7874C. It gives construction and mechanical features of the motors which are available in all commonly used ratings, both horizontal and vertical, 250 hp and up. The motors can be obtained with

Silco-Flex all-silicone-rubber insulating system which produces stator coils that reportedly are impervious to moisture and other air-borne contaminants, resistant to abrasives, and thermally stable at extreme operating temperatures.

EXCAVATOR. Koehring Division, 3026 West Concordia Ave., Milwaukee 16, Wis. Used as a two cu yd shovel, two to three

cu yd dragline or clamshell, or a 52-ton lift crane, the 805 Excavator was designed to fill a production gap on construction and material handling jobs, according to the manufacturer. In addition to those showing job applications, there are also photos that illustrate carbody, upper machinery, lower crawler frames and lower crawler assemblies.

(Continued on next page)

(Continued from previous page)

SILENT CHAIN DRIVES. *Link-Belt Co., Dept. PR, Prudential Plaza, Chicago 1, Ill.* Said to be one of the most comprehensive books ever written on the subject of silent chain drives, Book 2425 contains 88 pages of detailed engineering data and illustrations of silent chain's versatility in a wide range of applications. Tables of service factors, ratings, chain length and center computations are given. Pre-engineered stock drives are listed in one 16-page section. A 22-page section outlines the procedure for selection of engineered drives. Another section on drive components lists available chain widths, chain and wheel dimensions, wheel tolerances, materials and other data.

DRILL HEAD. *Austin Powder Co., Cleveland 13, Ohio.* This two-page bulletin, form LL-6126, describes the company's APA drag bit drill head. Literature discusses and illustrates how the step drilling pattern of the APA can increase penetration and reduce bit wear in air drilling of soft rock formations. Also given is an explanation of the advantages of the special APA carbide-tipped bits.

WROUGHT IRON O. D. PIPING. *A. M. Byers Co., Dept. C-3, Clark Bldg., Pittsburgh 22, Pa.* To show wrought iron's durability, booklet documents more than a score of typical commercial and industrial wrought iron pipe installations. Featured in the case histories is the colorful story of the wrought iron siphon installed in 1873 (and still in use today) to transport water from high in the Sierra Nevada's to Virginia City, Nev., then at its height as the center of rich Comstock Lode mining activities. ASTM specifications under which Byers pipe is manufactured are contained in the booklet, as are photo-micrographs showing the physical structure of the material.

SPECIFICATION FOR LEAD CHEMICAL LABORATORY DRAINAGE SYSTEMS. *Architectural Department, Lead Industries Association, 60 East 42nd St., New York 17, N. Y.* Lead Building Construction Bulletin No. 3 was prepared for the guidance of architects, engineers and plumbers in designing the chemical laboratory drainage systems for both industrial and educational facilities. Detailed drawings of suggested methods of installing lead waste lines for wall laboratory tables and center laboratory tables with center troughs and end sinks are included.

PRE-FABRICATED CABLE ASSEMBLIES. *Macwhyte Co., Prefabricated Assemblies Department, Kenosha, Wis.* In a recent bulletin called "Ropeology," Macwhyte Co. has announced prefabricate wire rope assemblies for original equipment installation. The bulletin pictures and describes several assemblies as well as showing several typical installations on equipment. Ask for Ropeology Bulletin No. 57126.

SINGLE ROLL CRUSHERS. *McLanahan & Stone Corp., Holidaysburg, Pa.* Bulletin FSD details McLanahan Black Diamond single-roll crushers. In addition to construction and design features, brochure includes dimensional drawings and data on capacities and horsepower required for crushing coal.

MOLDED HANDWEAR. *Mine Safety Appliances Co., Pittsburgh 8, Pa.* Gloves made of five types of molded rubber and synthetic materials in various weights, sizes and types are described in Bulletin 1310-2. A selection guide showing relative resistance of the different materials to nearly 200 common chemicals and their comparative physical characteristics is featured. A line of finger cots is also included.

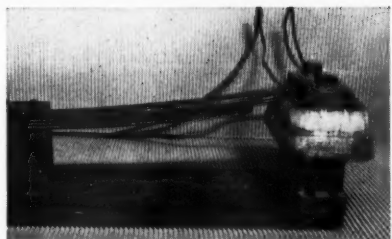
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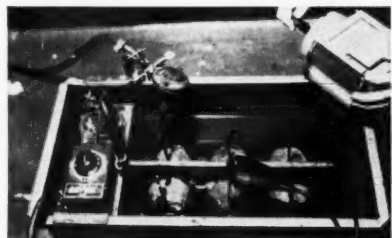


for longer life and more
reliable performance, use
National
Polyester Moulded
Field Coils



INCREASED STRENGTH

Complete polyester filling bonds all parts of the coil into a strong, unified, shock-resistant construction. The photograph at the left shows a shock test in which an energized and heated coil has been striking an anvil once a second for six months with no adverse effects.



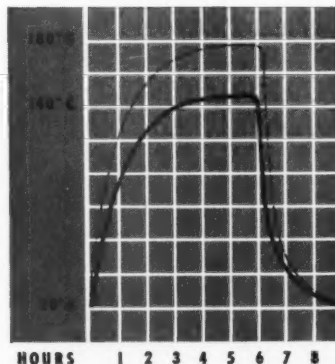
GREATER RESISTANCE TO CORROSIVE ENVIRONMENTS

Complete polyester filling prevents penetration of moisture, oil, conducting dust, and other foreign matter that contribute to coil failures. The photograph at left shows a test in which National polyester coils were immersed successively in water, hot oil, and an iron filing solution. Periodic resistance tests show *no deterioration* of the insulation after several months submersion.

National polyester-filled field coils can be installed in National service shops or supplied for installation by your own motor maintenance crews. Call your nearby National field engineer or write for details.

COOLER OPERATION

Absence of voids in the coil enhances heat transfer. The graph below shows comparative heating and cooling cycles for polyester-filled (solid line) and conventional varnish-treated (dotted line) field coils carrying the same amperage.



NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16, OHIO, U. S. A.



ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION—
REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES



"Talk up" increased
production—greater
safety...with these

M - S - A

COMMUNICATION

SYSTEMS

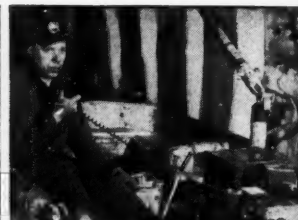
M-S-A MINEPHONE

Dispatcher sends orders instantly and simultaneously to all motormen with this modern, underground two-way voice communication system. Motormen receive and reply while trips are in motion—keep haulage movements coordinated with production demands. This results in smoother, faster, and more continuous trip movements throughout the mine.

Messages clear tracks for outgoing loaded trips and incoming empties. This system puts an end to traffic tie-ups, errors and accidents; prevents excessive stop-and-start strain on equipment. Write for more detailed information.



- Dispatcher sends orders to motormen . . . routes right-of-way traffic . . . receives reports on positions and station conditions.

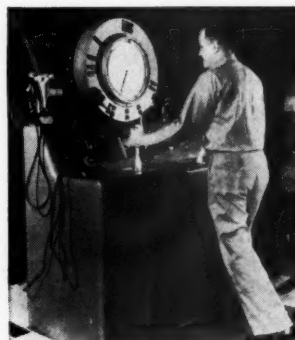


- "Jeep" operator requests instructions from dispatcher and maintenance shop for section assignment . . . speeds emergency repair.

M-S-A HOISTPHONE

For accurate, instant response between the hoisting engineer and cage, here's the voice communication system to install. Whatever the job—load leveling—shaft repairs—shaft inspection trips—passenger transportation—the M-S-A Hoist-Phone provides better safety and efficiency through dependable, continuous two-way voice communication at any level, and while the cage is in motion.

Requires no special training . . . simple to use . . . dependable in operation. Write for further information.



- The hoisting engineer is able to control all movements of the cage by communicating with cage rider over the M-S-A HoistPhone.



- Worker uses microphone in cage to tell the hoisting engineer where he wants to go. Loudspeaker mounted on top of cage.



When you have a safety problem, M-S-A is at your service . . .
our job is to help you

MINE SAFETY APPLIANCES COMPANY

201 North Braddock Avenue, Pittsburgh 8, Pa.

At Your Service: 77 Branch Offices in the United States and Mexico

MINE SAFETY APPLIANCES CO. OF CANADA, LTD.

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...speeds



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TD.
N.S.